NOMINATING PARTY:	**The United States of America**
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	**JUNE 2005 QUESTIONS ON CUNS FOR 2006 AND/OR 2007 FOR SOIL APPLICATIONS**
DATE	Version of August 18, 2005

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I. General questions:

Question 1. Has the registration status of 1,3-D and, thus, its suitability for karst geology and/or karst topography areas has changed recently, and if so, what is the new status?

ANSWER:
The registration status of 1,3-D has not changed in regards to karst geology or topography. The U.S. does not expect a further change in the registration status until mid 2007 at the earliest. Even if the registration status of 1,3-D were to change with respect to whether it could be used in situations of karst topography rather than karst geology the estimates of the amount of methyl bromide needed would not change. In making the assessment of critical need, therefore, the USG analyzed need as if the label change had already occurred

Question 2. Are there regulations which prevent the use of low barrier permeability films in any States other than California?

ANSWER:
The U.S. is not aware that any States other than California have regulations that prevent or severely restrict the use of low permeability barrier films.

Question 3. What mixtures of MB/Pic are registered in the different States covered by the CUN requests? MBTOC understands that a full range of mixtures (MB/Pic 98:2 to 2:98) can be applied in California, but in other States may be restricted by the premixed formulations of MB/Pic available in those States (e.g. 67:33, 50:50, 33:67). Please clarify.

ANSWER:
USG is not aware that any States have minimum application rate requirements for methyl bromide or specific regulations covering the ratio of methyl bromide to chloropicrin (i.e. premixed formulations)

II. Cucurbits:

Question 4. (Michigan): The Party states that 1,3-D/chloropicrin may be an effective alternative but growers will miss the optimal market window due to longer plant back times with this alternative. There may be scope for avoiding this problem through treatments in autumn preceding the crop. Please explain whether this is possible or not.

ANSWER:
The proposal by MBTOC to obviate the use of methyl bromide in Michigan by applying some alternative (specifically a combination of 1,3-D and chloropicrin) in the autumn preceding crop planting will not work on cucurbits. In Michigan, the predominant agricultural treatment that uses methyl bromide is one where methyl bromide is applied in strips of raised beds. Areas between the raised beds are not treated. In addition to the risk that the harsh winter conditions (prolonged periods of below freezing weather with snow, sleet, and high winds) will tear the plastic barrier, there is significant risk of flooding and concomitant recontamination of the treated areas. The length and severity of the winter means 4-5 months of precipitation is 'stored' in frozen form and released over the short period of thaw in the spring. This thaw-based flooding can be exacerbated by heavy rainfalls (in excess of 25 mm) that occur throughout the spring and summer in Michigan. Because Phytophthora and Verticillium are endemic in the areas of Michigan for which methyl bromide is being requested, flooding will transfer spores from the untreated to treated areas, resulting in additional infected plants and severe crop losses.

There are two additional problems which prevent a fall application of a methyl bromide alternative from being a viable alternative to the current practice. Deer walk across the fields, making holes in the plastic. Mice also burrow under the plastic. Once underneath they chew the drip tapes, rendering them inoperative and make burrows where they are in an ideal position to eat the newly planted material in the spring.

Question 5. (Regions: other than Michigan) The CUN was based on limited trial data. MBTOC requests further information to fully assess the other regions, in particular the relevance of recent trial results in SE USA, especially those using low permeability barrier films such as Gilreath et a12005a, and those which show new data for alternatives and their methods of application new application methods on cucurbits or similar crops from relevant production regions. (e.g. Gilreath et al 2005b,c)

ANSWER:
Several members of MBTOC and the USG were recently able to tour field research sites in Florida and Georgia including the plots of Dr. Gilreath. During those discussions and in his recent research publications (Gilreath et al 2005; Gilreath, Santos, Motis, Noling & Mirusso 2005; and Gilreath & Gilreath 2005) the improved pest control when using Virtually Impermeable Film (VIF) or metalized films (using an aluminum layer such as Canslit) was described. Dr. Gilreath and other researchers were contacted on the topics of low permeability barrier films, and newer application techniques. Based on their input it appears that VIF films have still not been widely adopted because of problems in: laying the films, inelasticity and the resultant difficulty in conforming to the bed shape, problems with linear shear, and the fact that embossed films are not available. The current versions of metalized films are being widely tested by several researchers and growers and they have the potential to reduce fumigant use rates with better laying and bedshape conforming characteristics. It is anticipated that the results of many of these research plots and growers field tests will be available next year. Use of metalized films present several questions for adoption, such as the fate of the aluminum coating if it “flakes off” on the soil during removal and the photostability of the coating during multiple crop cycles as is common in the southeastern U.S. An additional concern with all of the low permeability films and reduced use rates is poor uniformity of treatment unless the application equipment must be redesigned to accommodate reduced flow rates and pressure (Gilreath and Gilreath 2005). While these results are promising there are only a few researchers that have multi-year trials with these films and new or modified application equipment. Many growers are said to be testing the new films, reduced rates of methyl bromide, and other alternatives. Without multi-year trials under a range of environmental conditions the consistency, feasibility, and adaptability cannot be assessed.

When evaluating research that MBTOC cites (Gilreath et al 2003) the untreated control at the Bradenton site had 53 nutsedge (*Cyperus rotundus*) plants per square yard, while the Immokalee site had fewer than one plant per square yard. The current standard that the U.S. recommends for moderate nutsedge pressure is 5 to 30 plants per square yard. At the Bradenton site, the nutsedge control was not significantly different between MeBr:Pic (350 lb per acre) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb), but had 39% more nutsedge plants and 17% yield reduction. When comparing the same treatments at Immokalee, which had and no significant difference in *Fusarium*, or nematodes (such as *Meloidogyne* spp, *Belonolainus* spp*. and Tylenchorhynchus* spp.), but low nutsedge pressure (<1 plant per square yard), there was still a 12.5% reduction in yield compared to methyl bromide.

Question 6. MBTOC also seeks use rates of MB/Pic mixtures with lower MB than currently used (especially 30:70, 50:50) for control of the key pests in the nomination and also results of their technical efficacy.

ANSWER:
Communications with several researchers indicate that they have started, or are about to initiate, studies to look at long term performance of even lower rates of methyl bromide (at or below 200 kg/ha). These studies will encompass a wide range of environmental conditions, pest pressure, soil types, etc. and help to demonstrate consistency of control.

One of the studies that MBTOC cites is from Florida (Gilreath et al, 2005a), which looked at the impact of reduced rates of MB on pest control and pepper yield. In that study, which had high *Cyperus* spp. pressure, there were no significant differences in yield between any of the rates of methyl bromide with the different types of films. However, an examination of the change in yield with VIF treatments, compared to the standard MB treatments, suggests significant variability within treatments, which led to the lack of statistical significance in yield despite the large numerical differences in yield between treatments. Trials such as those conducted by Gilreath et al (2005a) with peppers, need to be conducted over several seasons, and preferably with different crops. The reality of the use of VIF for the 2007 season is its current prohibitive cost in the U.S., and even more significant, its lack of availability for use on a commercial scale. The Party does not anticipate these issues can be adequately resolved before the critical use season of 2007.

Table 1. Pepper yields are not significantly different but percent yield loss can be large.

	Treatment	**App Rate kg/ha**	**Yield t/ha**	**% Change**
1	Untreated		9.5	-31%
2	MeBr + Pic LDPE	392	13.8	0%
3	MeBr + Pic VIFP	196	10.8	-22%
4	MeBr + Pic VIFP	98	13.6	1%
5	MeBr + Pic VIFV	196	11.4	-17%
6	MeBr + Pic VIFV	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287.
LDPE is low density polyethylene, VIFP and VIFV are virtually impermeable film by Plastopil and Vikase respectively.

The research plots that MBTOC visited in Florida demonstrated that reliance on chloropicrin will not be sufficient to control nutsedge. Research by Gilreath and communications with him indicate that chloropicrin enhances nutsedge germination (this research has yet to be repeated for other pest species). Therefore, increasing the amount of chloropicrin applied can increase pest pressure and yield loss.

Question 7. The nomination indicates that MB is often not applied directly before cucurbits, but before the preceding crop as part of a double cropping process. MBTOC requests further clarification on how the proportion of the total crop area where MB is used immediately prior to cucurbits is determined.

ANSWER:

Cucurbits are widely grown in several states in the southeastern and midwestern U.S. Florida produces the largest crop of cucurbits. In Florida, cucurbits are grown in rotation usually with a solanaceous crop, such as tomatoes or peppers. However, none of the U.S. nomination is for cucurbits grown in Florida. In some states, either one crop per fumigation is grown, or, cucurbits are grown in rotation with another cucurbit crop. In evaluating the critical need for methyl bromide, USG has removed from the nomination requests in states where cucurbits are grown in rotation with solanaceous crops; all of the request is for the solanaceous crop with the cucurbit crop grown as a 'follow on'. For situations where the cucurbit is grown as a single crop, or is grown in rotation with the same or a different cucurbit crop, USG has compared the requested acreage with the acreage planted in cucurbits. The estimate of the area planted in cucurbits is derived from three main sources: a proprietary source that tracks pesticide use by crop, USDA's National Agricultural Statistical Service (NASS) database, and specialized state sources. These state sources differ from state to state—in California the main source is a database maintained by the California Department of Pesticide Regulation. In other states, such as Georgia, the University of Georgia maintains a website that reports on pesticide use by crop and county for all of the agricultural counties in Georgia. When sources are in disagreement, the data from the most detailed site was used.

The area reported in the BUNI as being in cucurbit cultivation is the area (and its proportion of the total area) that is used only for cucurbit cultivation (and not the area that is used for cucurbit cultivation in rotation with a non-cucurbit crop). For the most recent (2007) request, 3% of the Michigan cucurbit acreage, 34% of the southeastern cucurbit acreage, and 11% of the Georgia cucurbit acreage are included in the nomination.

Question 8. In SE and Georgia, the key pest is nutsedge. The Party states that potential alternatives, 1,3-D/Pic combinations and metham sodium, result in yield loss estimates of 29%. Estimates of yield differences are a determining factor in the relative economics of MB and the next best alternative. The Party refers to an old study on tomato production for yield data (Locascio 1997) and further information is requested to support the yield loss estimates relative to MB resulting from 1,3-D/chloropicrin combinations and metham sodium, with or without Pic, and other combinations such as 1,3-D + trifluralin 4-chloropicrin + napropamide.

ANSWER:
The article cited by MBTOC (Gilreath et al, 2003) examined methyl bromide plus chloropicrin (350 lb per acre of 67:33) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) for pepper yield. While the yields were not statistically different, numerically there was a 13 to 14% yield loss, compared to methyl bromide plus chloropicrin. The large yield loss differences suggest a large variability in the trials, which may be caused by inconsistent results of treatments. Therefore, based on MBTOC references there could be a 13 to 14% yield loss when comparing methyl bromide plus chloropicrin compared to this alternative. However, the USG had suggested a yield loss of 6.2 % in the BUNI. Importantly, the alternative treatment, which includes treatments with other chemicals, will require additional time for pesticide application and sufficient time to off-gas an additional chloropicrin treatment to prevent damage to transplants. This additional time delay could lead to impacts in terms of the key market windows, resulting in an economic loss over and above the yield losses. Techniques to remedy these problems are being studied, but will not be finalized in time for the 2007 season, for which MB is being requested by this nomination. This inconsistency in yield and additional soil treatment time argues for the economic infeasibility of this type of alternative until new methodology can alleviate these problems.

Table 2. Tomato yields are not significantly different but percent yield loss can be large

Treatment	Bradenton		Immokalee	
	Marketable Yield (pound per 10 plants)	**% Yield Change versus MeBr**	**Marketable Yield (pound per 10 plants)**	**% Yield Change versus MeBr**
Untreated	51	-56%	108	-16%
Methyl bromide:chloropicrin (350 lb of 67:33)	117	0%	128	0%
1,3-D-35%Pic + trifluralin + napropamide + chloropicrin (28 gal/0.5 lb/2 lb/125 lb)	101	-14%	112	-13%

Footnote: From Gilreath et al. 2003. Proc. Fla. State Hort. Soc.

Question 9. Recent references available to MBTOC demonstrate effective alternatives (metham sodium, with and without Pic) for moderate to heavy nutgrass control and further clarification is required on their suitability to karst and non karst areas (Johnson and Webster, 2001;Gilreath et a1 2005 b,c). Yields were similar to methyl bromide; however there was no data presented on plantback effects for cucurbits. Please provide clarification of yield loss and relevance of new studies to the nomination.

ANSWER:
Areas in the southeastern U.S experience frequent and heavy rainfalls, which may cause reduce efficacy of some pest control alternatives. In western North Carolina, in 2005, rain fell for 41 of the 61 days of June and July. Under these conditions 1,3 D/Pic combinations did not show effective control in fields where heavy nutsedge pressure was present. Combination treatments, including trifluralin, have shown stunting in tomato during such years of above average rainfall.

With regard to cucurbits, metham sodium with pic followed by use of halosulfuron (Sandea) will need to be evaluated in 2006, as it appears to researchers in the southeastern U.S. (personal communication North Carolina State University), that it holds probably the greatest potential for nutsedge control in tomato and cucurbits. Limited or no data is available on nutsedge control with this complete program. However, because there are lengthy plant back restrictions on common rotational crops (up to 36 months) the design of a crop rotation program will be very difficult and could restrict the planting of profitable crops.

III. Eggplants

Question 10. (Michigan): In Michigan, the key pests are *Phytophthora capsici* and Verticillium. The Party states that 1,3-D/chloropicrin may be an effective alternative, but growers will miss the optimal market window due to delayed plantback times. There may be scope for avoiding this problem through treatments in autumn preceding the crop. Please explain whether this is possible or not.

ANSWER:
The proposal by MBTOC to obviate the use of methyl bromide in Michigan by applying some alternative (such as a combination of 1,3-D and chloropicrin) in the autumn preceding crop planting will not work on eggplant. In Michigan, the predominant agricultural treatment that uses

methyl bromide is one where methyl bromide is applied in strips of raised beds. Areas between the raised beds are not treated. In addition to the risk that the harsh winter conditions (prolonged periods of below freezing weather with snow, sleet, and high winds) will tear the plastic barrier, there is significant risk of flooding and concomitant recontamination of the treated areas. The length and severity of the winter means 4-5 months of precipitation is ‘stored’ in frozen form and released over the short period of thaw in the spring. This thaw-based flooding can be exacerbated by heavy rainfalls (in excess of 25 mm) that occur throughout the spring and summer in Michigan. Because Phytophthora and Verticillium diseases are endemic in the areas of Michigan for which methyl bromide is being requested, flooding will transfer spores from the untreated to treated areas, resulting in additional infected plants and severe crop losses.

There are two additional problems which prevent a fall application of a methyl bromide alternative from being a viable alternative to the current practice. Deer walk across the fields, making holes in the plastic. Mice also burrow under the plastic. Once underneath they chew the drip tapes, rendering them inoperative and make burrows where they are in an ideal position to eat the newly planted material in the spring.

Question 11. (Regions other than Michigan): The CUN was based on limited trial data, and MBTOC requires further information to assess the other regions, in particular the relevance of recent trial results in SE USA especially those using low permeability barrier films (Gilreath et a12005a) and new application methods for alternatives (on cucurbits or similar crops from relevant production regions).

ANSWER:
Several members of MBTOC and the USG were recently able to tour field research sites in Florida and Georgia, including the research plots of Dr. Gilreath. During discussions with Dr. Gilreath, and in his recent research publications (Gilreath et al 2005, Gilreath et al in press, and Gilreath & Gilreath 2005) improved pest control with virtually impermeable film (VIF) or metalized films (using an aluminum layer such as Canslit) was described. The Party contacted Dr. Gilreath and other researchers concerning low-permeability barrier films, and newer application techniques. Based on their assessment it appears that VIF have still not been widely adopted because of problems in: laying the films, inelasticity and the resultant difficulty in conforming to the bed shape, problems with linear shear, and the fact that embossed films are not available. The current versions of metalized films are being widely tested by several researchers and growers and they have the potential to reduce fumigant use rates with better laying and bedshape conforming characteristics. It is anticipated that the results of many of these research plots and growers field tests will be available next year. These metalized films pose several questions for adoption: the fate of the aluminum coating if it “flakes off” on the soil during removal and the photostability of the coating during multiple crop cycles as is common in the southeastern U.S. These older soils are already high in aluminum and the impact of additional amounts and potential phytotoxicity will have to be tested. An additional concern with low-permeability films and reduced use rates is poor uniformity of treatment, unless the application equipment must be redesigned to accommodate reduced flow rates and pressure (Gilreath and Gilreath 2005). While these results are promising there are only a few researchers that have multi-year trials with these films and new or modified application equipment. Many growers are said to be testing the new films, reduced rates of methyl

bromide, and other alternatives. Without multi-year trials under a range of environmental conditions the consistency, feasibility, and adaptability cannot be assessed.

When evaluating research cited by MBTOC (Gilreath et al, 2003) the untreated control at the Bradenton site had 53 nutsedge (*Cyperus rotundus*) plants per square yard, while the Immokalee site had fewer than one plant per square yard. The current standard that the US recommends for moderate nutsedge pressure is 5 to 30 plants per square yard. At the Bradenton site the nutsedge control was not significantly different between MeBr:Pic (350 lb per acre) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) but had 39% more nutsedge plants and a 17% reduction in yield. When comparing the same treatments at Immokalee, which had and no significant difference in *Fusarium*, or nematodes (such as *Meloidogyne* spp, *Belonolainus* spp. *and Tylenchorhynchus* spp.), but low nutsedge pressure (<1 plant per square yard), there was still a 12.5% reduction in yield compared to methyl bromide.

Researchers in Georgia have also been conducting research on methyl bromide alternatives for eggplant production (Culpepper, Webster, Langston 2005) and the interaction of VIF and LDPE films. Their research presented in the following ten Tables shows promising results from VIF mulch versus LDPE but some early trends are apparent. The time of transplanting after fumigation may have to be increased (18 days versus 29 days) with different films, nutsedge control with Telone C35 followed by chloropicrin (35 gal followed by 150 lbs) was not as effective as methyl bromide: chloropicrin (67:33 at 400 lbs,), nutsedge control was not always enhanced with VIF versus LDPE (unfortunately nutsedge can readily emerge through either mulch), delaying planting at this site may have led to a yield reduction (5 to 9 lbs. per 22 feet of bed) with any of the treatments, eggplant yield (first three harvests pooled in pounds per plot)was somewhat higher with LDPE versus VIF (but not significantly different).

Table 3. Eggplant injury from various fumigant-mulch combinations at 64 days after fumigating in spring 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	0	0	0	0
DMDS + Chloropicrin (87.5:12.5)	700 lbs	0	11	0	0
Methyl Bromide + Chloropicrin (67:33)	400 lbs	0	2	0	0
Methyl Iodide + Chloropicrin (50:50)	400 lbs	2	16^	0	3
Telone C35 fb Chloropicrin	35 G fb 150 lbs	0	53^	0	30^
Telone II fb Vapam	12 G fb 75 G	21^	100^	0	13^
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	58^	90^	0	32^

Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	17^	98^	0	2

*All means can be compared using an LSD = 12. Fumigants were applied on February 16, 2005.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 4. Nutsedge response to various fumigant-mulch combinations at 90 days after fumigating in spring 2005.*

Fumigants**	Rates (broadcast rate)	Percent visual control		Number of nutsedge plants emerging through the mulch	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	0^	0^	154^	183^
DMDS + Chloropicrin (87.5:12.5)	700 lbs	40^	90	158^	38
Methyl Bromide + Chloropicrin (67:33)	400 lbs	93	86	17	34
Methyl Iodide + Chloropicrin (50:50)	400 lbs	88	88	28	48
Telone C35 fb Chloropicrin	35 G fb 150 lbs	70^	82^	87^	66^
Telone II fb Vapam	12 G fb 75 G	58^	67^	67^	111^
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	82^	68^	65^	89^
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	80^	65^	70^	117^

*Means within control estimated visually can be compared using an LSD = 11 while means within number of nutsedge plants penetrating through the plastic can be compared using an LSD = 29. Data for each variable pooled over planting dates. Fumigants were applied on February 16, 2005. Nutsedge counts taken on the entire 22 foot plot.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch within each variable.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 5. Eggplant heights affected by various fumigant-mulch combinations 60 days after fumigating in spring 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	14.4	12.8	11.8	10.8
DMDS + Chloropicrin (87.5:12.5)	700 lbs	12.6	9.3^	12.5	10.7
Methyl Bromide + Chloropicrin (67:33)	400 lbs	14	13.7	14.2	13.0
Methyl Iodide + Chloropicrin (50:50)	400 lbs	17.8^	9.8^	12.4	12.0
Telone C35 fb Chloropicrin	35 G fb 150 lbs	14.1	5.5^	14.1	9.9^
Telone II fb Vapam	12 G fb 75 G	9.6^	0.0^	12.5	11.3
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	6.7^	1.0^	13.8	9.0^
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	11.2	0.0^	12.4	12.0

*All means can be compared using an LSD = 3.5. Fumigants were applied on February 16, 2005.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 6. Eggplant heights affected by various fumigant-mulch combinations 90 days after fumigating in spring 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	51.5	50.8	45.7	47.7
DMDS + Chloropicrin (87.5:12.5)	700 lbs	57.6	53.2	60.1	58.4
Methyl Bromide + Chloropicrin (67:33)	400 lbs	58.8	62.0	64.7	66.4
Methyl Iodide + Chloropicrin (50:50)	400 lbs	57.8	55.7	61.1	63.3

Telone C35 fb Chloropicrin	35 G fb 150 lbs	61.6	38.0^	59.2	46.9
Telone II fb Vapam	12 G fb 75 G	49.8	0^	62.5	55.2
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	45.1	3.6^	55.3	50.8
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	48.6	0.3^	58.1	59

*All means can be compared using an LSD =14.4. Fumigants were applied on February 16, 2005.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 7. Number of eggplant harvested during the first harvest date comparing fumigant-mulch treatments in spring of 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	31	30	20	22
DMDS + Chloropicrin (87.5:12.5)	700 lbs	31	34	22	19
Methyl Bromide + Chloropicrin (67:33)	400 lbs	30	33	15^	12^
Methyl Iodide + Chloropicrin (50:50)	400 lbs	34	31	14^	15^
Telone C35 fb Chloropicrin	35 G fb 150 lbs	26	17^	20	17^
Telone II fb Vapam	12 G fb 75 G	29	0^	15^	14^
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	30	2^	17^	15^
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	30	1^	15^	16^

*All means can be compared using an LSD =13. Fumigants were applied on February 16, 2005. Harvest one was made on May 17, 2005. The entire plot of 22 feet was harvested.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 8. Weight of eggplant fruit (lbs) harvested during the first harvest date comparing fumigant-mulch treatments in spring 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	40	44	35	35
DMDS + Chloropicrin (87.5:12.5)	700 lbs	40	48	33	27
Methyl Bromide + Chloropicrin (67:33)	400 lbs	40	44	20^	17^
Methyl Iodide + Chloropicrin (50:50)	400 lbs	43	43	18^	23^
Telone C35 fb Chloropicrin	35 G fb 150 lbs	34	25^	30	24^
Telone II fb Vapam	12 G fb 75 G	39	0^	21^	14^
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	41	3^	23^	21^
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	41	2^	21^	24^

*All means can be compared using an LSD =11. Fumigants were applied on February 16, 2005. Harvest one was made on May 17, 2005. The entire plot of 22 feet was harvested.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 9. Number of eggplant harvested pooled over the first three harvests comparing fumigant-mulch treatments in spring of 2005.*

Fumigants**	Rates	Plant date 1 (Planted 18 days after fumigating)	Plant date 2 (Planted 29 days after fumigating)

	(broadcast rate)	LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	68	78	64^	65^
DMDS + Chloropicrin (87.5:12.5)	700 lbs	78	79	73	62^
Methyl Bromide + Chloropicrin (67:33)	400 lbs	89	77	70	63
Methyl Iodide + Chloropicrin (50:50)	400 lbs	85	83	62^	61^
Telone C35 fb Chloropicrin	35 G fb 150 lbs	72	50^	74	73
Telone II fb Vapam	12 G fb 75 G	73	0^	70	53^
Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	78	7^	64^	54^
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	80	3^	58^	69

*All means can be compared using an LSD =22. Fumigants were applied on February 16, 2005. The entire plot of 22 feet was harvested three times.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 10. Weight of eggplant fruit (lbs) harvested pooled over the first three harvests comparing fumigant-mulch treatments in spring 2005.*

Fumigants**	Rates (broadcast rate)	Plant date 1 (Planted 18 days after fumigating)		Plant date 2 (Planted 29 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
None	0	90	109	96	98
DMDS + Chloropicrin (87.5:12.5)	700 lbs	102	111	105	84
Methyl Bromide + Chloropicrin (67:33)	400 lbs	119	104	95	82
Methyl Iodide + Chloropicrin (50:50)	400 lbs	106	117	83	86
Telone C35 fb Chloropicrin	35 G fb 150 lbs	96	75	114	106
Telone II fb Vapam	12 G fb 75 G	105	49^	97	69

Telone II fb Vapam fb Chloropicrin	12 G fb 75 G fb 150 lbs	108	11^	88	75
Telone II fb Vapam fb Chloropicrin	12 G fb 50 G fb 100 lbs	109	5^	81	99

*All means can be compared using an LSD =41. Fumigants were applied on February 16, 2005. The entire plot of 22 feet was harvested three times.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per bed. Vapam was injected into the soil with blades 4.5 inches apart. Vapam was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Question 12. MBTOC also seeks the current registration status and use rates of MB:Pic mixtures with lower MB than currently used (especially 30:70, 50:50) for control of the key pests in the nomination and also results of their technical efficacy.

ANSWER:
For preplant soil use the U.S. EPA has not made any recent label changes to the methyl bromide or chloropicrin labels. The U.S. label does not have any minimum application rate requirements for methyl bromide or specific regulations covering the ratio of methyl bromide to chloropicrin. The U.S. is not aware of any states with minimum application rate requirements for methyl bromide or specific regulations covering the ratio of methyl bromide.

In past years the majority of preplant fumigant alternatives research on small fruits and vegetables has been directed at strawberry, tomato, and pepper crops. Based on questions from MBTOC the vegetable focus has moved towards eggplant and cucurbits. Based on this reprioritization we hope that MBTOC will understand that the numbers and extent of research studies on tomato and pepper problems will be constrained in future years. While the new research is being conducted the actual data is not yet available. Two studies on cucurbits are presented below to provide examples of the types of work that are ongoing.

Research in Georgia by Grey, Culpepper, and Webster (2003) looked at the suitability of herbicides applied under plastic for weed control. In their research they looked at halosulfuron, metolachlor and sulfentrazone applied in the spring, under plastic. That work suggested that several of the vegetable crops such as eggplant, cucumber, transplanted and seeded squash were initially injured. However, by the end of the study only squash, cucumber, and potentially eggplant and cabbage were potentially intolerant of these selective herbicides. Due to differences in soil types and water permeability this toxicity may be higher in Florida.

Table 11. Vegetable injury from halosulfuron, metolachlor and sulfentrazone.

Treatments	Rate (kg ai/ha)	% Crop Injury
Halosulfuron Metolachlor Metolachlor + Halosulfuron Sulfentrazone	0.027 1.12 1.12 + 0.027 0.28	8 to 16% for eggplant, cucumber, transplanted and seeded squash < 4% for cabbage

Footnote. From Grey, Culpepper, and Webster 2003.

Table 12. Vegetable tolerance halosulfuron, metolachlor and sulfentrazone.

Treatments	Rate (kg ai/ha)	Crop Tolerance (Measured by Yield)	Crop Intolerant (Measured by Yield)
Halosulfuron	0.027	Cabbage, eggplant, squash and cucumber tolerant	Not described
Metolachlor	1.12	Cabbage and eggplant	Squash and cucumber
Metolachlor + Halosulfuron	1.12 + 0.027	Not described	Not described
Sulfentrazone	0.28	Eggplant and cabbage warrant further investigation but caused injury	Squash and cucumber

Footnote. From Grey et al 2003.

Research in Georgia by W. C. Johnson (2003) looked at metham-sodium for yellow nutsedge (*Cyperus esculentus*) control in cantaloupe. In 2001 and 2002, in Georgia, this research examined full rate and half rate applications of metham-sodium versus untreated plots applied 1, 2, or 3 weeks before transplanting. In this study metham-sodium applied with a power tiller at the full rate (see Johnson and Webster, 2001) 2 weeks before transplanting provided the best nutsedge control (data not presented) combined with least injury to the transplants. The half rate application or treatments applied 1 or 3 weeks before transplanting were not as effective. This suggests that timing of application and method of application are as important as use rate for providing effective control of nutsedge without damage to the transplants.

Question 13. The nomination indicates that MB is often not applied directly before eggplant, but before the preceding crop. MBTOC requests further clarification on how the proportion of the total crop area where MB is used immediately prior to eggplants is determined.

ANSWER:

Eggplant is a very minor crop in the U.S., accounting for fewer than 2850 hectares on a national basis. It is grown in about a dozen states, including Florida, Georgia and Michigan (areas that have a critical need for methyl bromide) and New Jersey, Massachusetts and others, where alternatives are used. In evaluating the critical need for methyl bromide USG has removed from the nomination all requests in states where eggplants are grown in rotation with another crop within one year. For situations where eggplant is grown as a single crop, or is grown in rotation with eggplant (double-cropped), USG has compared the requested area with the area planted in eggplant. The estimate of the area planted in eggplant is derived from three main sources: a proprietary source that tracks pesticide use by crop, USDA's National Agricultural Statistical Service database (NASS), and specialized state sources. These state sources differ from state to state—in California the main source is a database maintained by the California Department of Pesticide Regulation. In other states, such as Georgia, the University of Georgia maintains a website that reports on crop acres by county for all of the agricultural counties in Georgia. When sources are in disagreement, the data from the most detailed site was used.

The area reported in the BUNI as being cultivated with eggplant is the area (and its proportion of the total area) that is only used for eggplant cultivation, and not the area that is used for eggplant cultivation in rotation with a non-eggplant crop within one year. For the most recent (2007) request, 60% of the Georgia eggplant cultivation, and 100% of the Florida eggplant cultivation are included in the nomination. USG was not able to determine the proportion of the Michigan eggplant that is contained in the nomination, but as 33 hectares were requested for Michigan eggplant, USG is confident that at least this number of hectares is in eggplant production and not rotated with non-eggplant crops.

Question 14. In Georgia and Florida, nematodes, soil borne fungi and nutsedge are the key pests. The Party states that 1,3-D + chloropicrin + trifluralin + napropamide is an effective alternative in Florida except in areas of karst topography which comprise 40% of the growing acreage. 1,3-D/chloropicrin is effective against nematodes, but not nutsedge. Although not controlling nutsedge as well as MB, this combination provided equivalent yields in spring and fall crops in Tifton GA (Culpepper and Langston, 2004). Party is requested to clarify why this information is not relevant to the nomination.

ANSWER:
MBTOC has cited the U.S. nomination package that states that 1,3-D is not suitable under conditions of karst topography then cites the 1,3-D research of Culpepper Langston (2004) and asks about its relevance to the nomination. That research is described below. In cases where an alternative cannot be used due to a regulatory restriction, the U.S. has not described that research because MBTOC has clearly stated that they do not want information on chemicals that are not registered for those sites. If the description below does not adequately answer the question please contact the U.S. for additional information.

The research of Culpepper and Langston (2004) looked at yellow and purple nutsedge control and pepper yield for methyl bromide versus combinations of Telone (1,3-dichloropropene) alone, with chloropicrin or K-Pam (metam potassium) versus Midas (iodomethane). The research results are shown in Table 5 and 6 below. In this study there was no statistically significant yield loss when comparing methyl bromide (400 lb of 67:33) to Telone II (12 gal/acre) followed by chloropicrin (150 lb per acre), but numerically, a 7% yield loss was demonstrated. However, in the alternative treatment, nutsedge control was significantly reduced compared to methyl bromide. Therefore, in subsequent crop cycles the weed pressure would likely be even greater.

Fumigant treatment options, rates, and application methods were as follows (Culpepper and Langston, 2004):

1. Methyl Bromide 67:33 (400 lb/A broadcast) injected 6-8" in the bed with a Super-Bedder plastic layer.
2. Telone II (12 gal/A broadcast) injected 10-12 inches deep with a Yetter rig followed with Chloropicrin (150 lb/A broadcast) injected 6-8 inches in the bed with a Super-Bedder plastic layer.
3. Telone C35 (35 gal/A broadcast) injected 10-12 inches deep with a Yetter rig followed with Chloropicrin (150 lb/A broadcast) injected 6-8 inches in the bed with a Super-Bedder plastic layer.
4. Telone II (12 gal/A broadcast) injected 10-12 inches deep with a Yetter rig followed with K-Pam (46 gal/A broadcast) incorporated 3-4 inches deep with a tilrovator and followed with a Super-Bedder plastic layer.
5. MIDAS 98:2 (175 lb/A broadcast) injected 6-8" in the bed with a Super-Bedder plastic layer.
6. Inline (35 gal/treated acre) injected through two lines of drip tape the day following laying plastic.
7. No fumigant under plastic.

Table 13. Methyl Bromide Alternatives Impact on Yellow and Purple Nutsedge Control. TyTy, Georgia. Fall, 2003.

	Percent Late Season Control	
Fumigant Option	**Yellow Nutsedge**	**Purple Nutsedge**
Methyl Bromide	92 a	80 a
Telone II plus K-Pam	79 a	50 c
Telone II plus Chloropicrin	52 b	31 d
Telone C35 plus Chloropicrin	92 a	65 b
Midas	87 a	49 c
Inline	50 b	16 e
No Fumigant	36 c	12 e

Fumigant main effects were significant.
Values within a column followed by the same letter are not significantly different at P = 0.05.

Table 14. Methyl Bromide Alternatives Impact on the Number of 28 lb. boxes of peppers harvested per acre. TyTy, Georgia. Fall, 2003.

Fumigant Option	**Percent Loss in boxes per acre compared to Methyl Bromide**
Methyl Bromide	0
Telone II plus K-Pam	7
Telone II plus Chloropicrin	17*
Telone C35 plus Chloropicrin	22*
Midas	16*
Inline	36*
No Fumigant	48*

Values are pooled over two herbicide options as fumigant main effects were significant.
*Denotes a statistical loss in yield compared to Methyl Bromide at P = 0.05.

Question 15. An effective strategy for controlling nematodes, pathogens and nutsedge has been demonstrated in Florida as described above. Also, recent references available to MBTOC demonstrate effective alternatives (metham sodium, with and without Pic) for moderate to heavy nutgrass control in similar regions for non-karst and karst areas (Johnson and Webster, 2001; Gilreath et al, 2005 b,c). Yields were similar to methyl bromide, however there was no data presented on plantback effects for eggplants. It is not clear why this combination cannot be used in 92% of Georgia nomination where karst topography is not a concern. Please clarify

ANSWER:

Communications with several researchers indicate that they have started, or are about to initiate, studies to look at long-term performance of alternatives for eggplant. These studies will encompass a wide range of environmental conditions, pest pressure, soil types, etc. and help to demonstrate consistency of control. However, to date the U.S. has still not seen consistent control for multiple years for these alternatives (see summaries below).

One of the studies that MBTOC cites is from Florida (Gilreath et al, 2005a), which looked at the impact of reduced rates of MB on pest control and pepper yield. In that study, which had high *Cyperus* spp. pressure, there were no significant differences in yield between any of the rates of methyl bromide with the different types of films. However, an examination of the change in yield with VIF treatments, compared to the standard MB treatments, suggests significant variability within treatments, which led to the lack of statistical significance in yield despite the large numerical differences in yield between treatments. Trials such as those conducted by Gilreath et al (2005a) with peppers, need to be conducted over several seasons, and preferably with different crops. The reality of the use of VIF for the 2007 season is its current prohibitive cost in the U.S., and even more significant, its lack of availability for use on a commercial scale. The Party does not anticipate these issues can be adequately resolved before the critical use season of 2007.

Table 15. Pepper yields are not significantly different but percent yield loss can be large.

	Treatment	**App Rate kg/ha**	**Yield t/ha**	**% Change**
1	Untreated		9.5	-31%
2	MeBr + Pic LDPE	392	13.8	0%
3	MeBr + Pic VIFP	196	10.8	-22%
4	MeBr + Pic VIFP	98	13.6	1%
5	MeBr + Pic VIFV	196	11.4	-17%
6	MeBr + Pic VIFV	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287.
LDPE is low density polyethylene, VIFP and VIFV are virtually impermeable film by Plastopil and Vikase respectively.

The research plots that MBTOC visited in Florida clearly demonstrated that chloropicrin will not control weeds such as *Cyperus esculentus* or *C. rotundus* . Research by Gilreath and communications with him indicate that chloropicrin enhances nutsedge germination (this research has yet to be repeated for other pest species). Therefore, increasing the amount of chloropicrin applied can increase pest pressure and yield loss.

Another study by Gilreath, Santos, Motis, Noling and Mirusso (2005) looked at nematode and *Cyperus* control in bell pepper (*Capsicum annum*). In that study the authors stated “For bell pepper yield, the application of metam sodium and metam sodium + chloropicrin provided similar fruit weight as for methyl bromide + chloropicrin in two of the three seasons.” However, in that year (Fall, 2002) the yields went from 18.8 t/ha for methyl bromide + chloropicrin to 13.7 t/ha for metam sodium + chloropicrin, or a 27% drop in yield. This level of yield loss could have severe economic impacts for a grower. Because of the inconsistency of some of the alternative treatments the U.S. does not consider them to be a replacement for methyl bromide. The work of Johnson and Webster (2001) as described in Question 12 above indicated that for metam sodium the time of application before transplanting, rate, and type of incorporation equipment all can have significant impacts on performance of the chemicals.

Question 16. Yield differences are the principal factor in economic analyses on economic feasibility of technically suitable alternatives for these regions. These yield differences are estimated for eggplant on the basis of some tomato data including Locascio (1997). Party is asked to validate the yield losses for alternatives on direct observations on eggplants

ANSWER:
Communications with several researchers indicated that they have initiated studies to look at long term performance of alternatives for eggplant. These studies will encompass a wide range of environmental conditions, pest pressure, soil types, etc. and help to demonstrate consistency of control. Until these studies are complete the U.S. has relied on surrogate crops to help demonstrate yield and pest control differences. Perhaps MBTOC could share some of the yield loss estimates from other countries to help illustrate their concerns.

IV. Forest Nurseries:

Question 17. MBTOC is unclear why regions A, B, D and F, which presently use MB/Pic 98:2 cannot use similar mixtures of MB/Pic 67:33 (as used by the other regions) which are considered to be technically effective in control of weeds and pathogens. Further clarification is requested.

ANSWER:
A key pest problem for these four nominees is nutsedge, given their geographical locations, with hot, humid summers. The U.S. nomination is only for those areas with moderate to severe pest problems (not the entire area where these forest nurseries are in operation). Nurseries with little nutsedge pressure have found that a MeBr:chloropicrin formulation of 67:33 provides acceptable weed control, as well as good disease control. Nurseries with high nutsedge pressure routinely use a MeBr:chloropicrin formulation of 98:2, as this gives them better nutsedge control, even in the subsequent crop, in addition to good disease control. Nurseries that have lowered the formulation ratio from 98:2 to 67:33 frequently have found that they need higher rates of the formulated compound to get adequate control (e.g., 440 kg/ha of 67:33 vs. 390 kg/ha of 98:2), even with reduced weed pressure. Thus, the amount of MB commonly used is only somewhat less than with the 98:2 formulation. Nurseries that have been able to lower the formulation ratio are almost always in locations without severe infestations of nutsedge. Research is being conducted on-site in many of these nurseries (personal communication, International Paper [Region B]; Southern Forest Nursery Management Cooperative [Region A]) to try to reduce the rate of MB while maintaining adequate weed and disease control. However, the Party submits that MB will still be critical for the 2007 use season. USG will provide these results when they become available.

The Northeastern Forest and Conservation Nursery Association [Region F] provided the following clarification (*information was provided by the four largest users of MB/Pic 98:2 in the Association and by the contract applicator of methyl bromide for these nurseries. Observations reported from these users were made under operational conditions, not from research plots*):

The current largest users of 98:2 in the consortium reported they had tried the 67:33 mixtures in their nurseries at one time or another. These users report that the 67:33 formulation at the standard application rate of 350 lbs./A was less effective in controlling weeds, including nutsedge, than the

98:2 mixture at 350-400 lbs/A. They felt that 67:33 would need to be applied at a higher rate if it was to be as effective as 98:2, which would offset any reduction in methyl bromide by using the 67:33formulation.

One nursery also observed that mycorrhizal recolonization of seed beds fumigated with 67:33 appeared to be less than that in beds fumigated with 98:2, leading to stunting of seedlings of several tree species.

All users of 67:33 also reported that this mixture caused severe nasal irritation and nausea to workers removing plastic tarps as much as 7 days after fumigation. Protective gear needed to prevent these symptoms would be extremely uncomfortable, and perhaps even cause heat-related injuries, in the weather conditions usually found in August and early September in the nurseries in this consortium.

Weyerhaeuser Company [Region D] provided the following clarification (also, see Appendix A for a summary of Weyerhaeuser research studies pertinent to the MB nomination):

The fumigation selection process is complex and a result of soil testing and analysis, including the following factors: (1) timing- spring versus fall fumigation; (2) target pathogens; (3) contractor application; and (4) historical efficacy data.

Historically, within Weyerhaeuser Company, numerous earlier studies tested MEBR:PIC efficacy as 98:2 or 67:33, but not in the context of direct “head-to-head” comparison. Our southern nursery seedling production has maintained a long track record of effectively using the MEBR:PIC 98:2 formulation with tarp for pathogen and weed control. These facilities are situated on similar sandy soils, typically low in organic matter (<2%). Pre- and post-fumigation efficacy testing over a number of years demonstrates that this treatment combination can yield an expectation of >90% reduction in key pathogen complexes such as *Fusarium* and *Pythium*. This treatment effect is managed so that soil fumigation is used once, every three to four years, or longer on a particular crop production area. Thus, MEBR:PIC 98:2 soil treatment has been the standard soil treatment within southern Weyerhaeuser facilities for the last 25 years, and is directly responsible for successful seedling production (~ 2 billion seedlings) and regeneration of millions of acres.

Our alternatives fumigate testing (Weyerhaeuser Co.) during the late 1990’s focused on chloropicrin (PIC) as the “next best case” tool for effective soil pathogen management. This was largely driven off the historic use of MeBr:Pic 67:33 in our western Weyerhaeuser nursery production facilities (likewise, a 25+ year track record of similar production). These facilities are situated on heavier loam to sandy-loam soils with high organic matter (5-10%). We observed that with increased levels of PIC, fumigation was more effective, especially on root residual pathogens. Similarly, later trials conducted by us in the South showed that Pic (200 lbs-300 lbs/ac) [~220-330 kg/ha] or in combination with Telone-PIC could be as effective as MeBr:Pic 98:2, both in the longevity of the fumigation effect and in aspects of seedling production (except noxious weed control). However, as described below longer off-gassing has been a problem with chloropicrin.

Fall is the preferred timing of fumigant application, since it allows for the most effective soil management, preparation, and temperature conditions conducive to treatment. MB has the unique property of being the chemical least affected by soil temperature. Soil moisture also plays a large role in fumigant efficacy, but it affects a broad class of chemical agents, including MB. The higher concentration of MB in the 98:2 formulation versus 67:33 might have some advantages to penetration of compacted soil, tills and to some degree soil depth. This advantage may be greater under spring fumigation conditions when soil properties may not be ideal for fumigation. We have had several instances of late-spring soil fumigation with MeBr:Pic 67:33, where incomplete off-gassing has occurred, which could not be detected with a MeBr meter, and which caused considerable post-transplant seedling mortality. This damage was most likely caused by the slower off-gassing by the PIC component, facilitated by a cool wet spring.

Our soil pathogen monitoring program is designed to target critical pathogen groups which historically have caused the greatest damage to seedling production. Against these pathogens (mostly *Fusarium* and *Pythium* species), we have arrayed tests using many of the front-line fumigant agents (MEBR:PIC, PIC, Telone-PIC, Metam Sodium, Basamid, and others). To date, we feel confident that MEBR:PIC 98:2 and MEBR:PIC 67:33 would show similar efficacy against these pest complexes under the range of treatment and soil conditions represented in our different facilities. However, we have yet to conclude that CT values (critical exposure time for MB) can be achieved for weed pests in the South with the short tarping interval that is being used (7 days versus 20+days South versus West respectively). I suspect the short tarping period is more a function of climatic factors such as wind force, than simply contractor recommendations.

We now have some preliminary data from one facility in Washington State that suggests that MeBr:Pic 67:33 may not completely control a new root pathogen, *Cylindrocarpon*. The appearance and dominance by this pathogen may coincide with decade long change from cover crop to bare-fallow practiced between fumigation events. We are currently investigating the possible link between the lack of beneficial soil microbes under bare fallow and increased pathology by *Cylindrocarpo*n. However, Pic applied at 300+lbs/ac [330 kg/ha] does seem to control this pathogen. In the future, we suggest that facilities may need to rotate fumigant chemicals during upcoming fumigation cycles to head off this phenomenon.

I do not know the current contractor preference for which fumigant is used by facility. In several attempts we have been unable to secure some materials for testing, or equipment to apply those chemicals have not been available. Since MeBr:Pic 98:2 and MEBR:PIC 67:33 do not fit this criteria, I don't see any reason why either formulation could not be available for use in any given facility or year.

In conclusion, I don't see a pathological reason to exclude the MEBR:PIC 67:33 formulation from use in Southern and Western facilities. Other formulations with lower MB concentrations (50:50) would need to be tested over several crop cycles. My only reservations would be on the substitution of MeBr:Pic 67:33 for MeBr:Pic 98:2 for spring fumigation. The time interval between to fumigate and to off-gas is very short, and a delay of 1-month to plant or longer can have serious economic consequences to normal seed germination and seedling production.

Question 18. Research is ongoing to determine if Pic with metham, 1,3-D and/or herbicides can provide acceptable control of high levels of nutsedge. To date, metham sodium and chloropicrin in combination showed promising results, but when used without plastic sheeting caused severe crop injury: MBTOC considers that this treatment (and others) covered with plastic films, particularly low permeability barrier films, may provide an effective technical alternative and avoid crop injury Further clarification is required on the technical efficacy of this treatment. MBTOC accepts that some barrier films may be difficult to apply in broadacre continuous applications, and requests clarification on what films have been evaluated and the suitability of these films for application and use;

ANSWER:
As MBTOC has stated, the use of metham without tarping is not feasible due to crop injury and worker exposure issues. It might appear appropriate, then, to tarp the material to prevent out-gassing problems. However, the application of metham followed by chloropicrin under flat-tarping, considering the large number of hectares treated each year, is not practical or cost effective, and currently, not technically feasible (personal communication, International Paper [Region B]; Southern Forest Nursery Management Cooperative [Region A]). A three-step process would be required, first application of metham, then chloropicrin, and finally, application of the tarp. Incorporation of metham using a rotovator is an extremely slow process, and the area to be treated within a given treatment window (determined by weather: temperature, moisture, wind) is limited. This window of application is generally 4-6 weeks, and even under the best application methods, this treatment takes four times as long to apply as the typical MB treatment. Therefore, to treat the necessary hectares each year would require a four-fold increase in labor and additional available equipment in order to apply metham, chloropicrin and cover with tarp. According to the label, and depending on soil and weather conditions, there would be a two to six week delay before planting after application of metham, chloropicrin and tarp-covering. This would affect market production costs.

The equipment needed to treat the area in spring and fall would not be available without the purchase of four additional applicator units and would greatly increase the cost to growers, as would the “set-up” time for the treatment with additional machinery. In order for tarps to be placed on the treated metham areas, workers must return into the treated area to lay down tarps after chloropicrin has been injected into the soil. In this case, out-gassing occurs, and workers must wear personal protection equipment that is not practical given the temperatures that normally occur at the time of application. Nursery growers of these regions are currently using high density films to decrease emissions of MB, but have found that for current production VIF is not an option due to excessive costs and technical difficulties of gluing during application. Nursery members of the Southern Forest Nursery Cooperative, among others, are experimenting with VIF, but are not able to adopt this technology for their 2007 production.

The Northeastern Forest and Conservation Nursery Association [Region F] provided the following clarification:

The consortium has no additional information on the technical efficacy of the treatments in question. There are no commercial applicators in the region that have the capability to apply VIF in broadacre applications, so these treatment combinations have not been evaluated. All methyl bromide applied by the consortium is done under by 1 mil polyethylene film that is glued together to cover the entire field.

Weyerhaeuser Company [Region D] provided the following clarification (also, see Appendix A for a summary of Weyerhaeuser research studies pertinent to the MB nomination):

Our research experience has been that PIC and Telone-PIC have tested with nearly the same efficacy as MB across various facilities, crop types (seedbed or transplants) and years. Essentially, all this test data has been done in association with standard fumigation tarping (1-2 mil plastic). This is also true for MIT agents, such as Basamid, Metam, Busan, Soil Prep, or Vapam. In this later chemical group, we have also shown that efficacy is tied to the use of plastic tarp. Furthermore, MIT agents require conversion before they become effective fumigants. Conversion is both temperature and moisture dependent.

The use of mixtures of PIC+Metam or Telone-PIC+Metam in agriculture settings does not mirror larger nursery scale site fumigation with MeBr:Pic, PIC or Telone-PIC. In fall nursery fumigation, it is difficult to manage for uniform soil moisture over a large acreage. Irrigation pipelines are removed to facilitate land preparation for fumigation. Soil temperature must also be maintained in a range above 50F for effective conversion. This severely restricts the timing in the fall, but in most years, effectively removes the likelihood of using MIT agents in combination with other fumigants for spring fumigation.

A more effective barrier would potentially provide two aspects to mitigate the issue of conversion. First, the barrier composition should facilitate solarization of the soil to maintain the optimal temperature regime for conversion and to retain soil moisture. Conventional fumigation tarp (1-mil thickness) in solarization tests conducted at our Magnolia (AR) and Mima (WA) did not function as a heat sink as well as thicker mil plastic (6 mil), nor did it physically last sufficiently long to solarize the soil.

We have observed several severe deficiencies in MIT agents that have not been observed in tests using other agents. In these examples, we have not been able to deduce whether the negative crop effects are based on residual MIT caused soil phytotoxicity or lack of control of non-target pathogen groups (one's we do not currently monitor).

Tarp cost is also a limiting next step. Costs increase dramatically with thickness and area being covered. Currently, standard 1-mil tarp is adequate to achieve the treatment efficacy (> 90+% reduction in soil pathogen population in numbers and area).

We suggest that MITC agents can be a viable component of a comprehensive fumigation plan for any nursery facility. We have prepared to test a formulation of Telone-PIC-Metam, but the equipment was not available for injection of the later. Our understanding of the limitations of MIT agents and the cultural aspects to facilitate optimal conversion offers further interest in testing these mixtures.

Question 19. MBTOC also requests further information on whether 1,3-D/Pic + metham sodium (or glyphosate) can be used in place of MB/Pic formulations to control nutsedge (Culpepper and Langston, 2004). MBTOC also requests clarification from the Party of the availability and effects of VIF films used with MB:Pic mixtures or alternatives to control persistent targets (e.g. nutgrass)as this can further reduce rates (Gilreath et al 2005a).

ANSWER:
Forest tree seedlings cannot be exposed to glyphosate as the herbicide kills both hardwood and conifer species (personal communication, International Paper [Region B]; Southern Forest Nursery Management Cooperative [Region A]). While ‘shielded sprayers’ with glyphosate have been tested in small trials, seedling mortality from over-spray does occur. An International Paper nursery, for example, will typically produce 300 million seedlings per year, and so, even 1% mortality due to herbicide sprays could result in significant seedling loss. Consequently, glyphosate would not be an option to control nutsedge in nursery beds.

MBTOC cited studies by Gilreath et al. and Culpepper and Langston. The crops used for these studies were eggplant and pepper, which require strip-tarping. Results of these studies are not applicable to the flat-tarping system used by forest tree nurseries. Field trials evaluating VIF have been conducted by members of the Southern Forest Nursery Cooperative. Because of its virtually impermeable character, however, glues have not been adequately developed that are amenable to VIF material, which must withstand harsh field conditions. Thus, while this method has great potential, it will not be technically feasible for the 2007 production season. In addition, there is a limited supply of VIF, even for research purposes. Nursery managers have stated that they cannot get the VIF material in the quantities needed, especially at an acceptable price. Therefore, the technology is currently not economically feasible, and MB will be critical for the 2007 growing season.

The Northeastern Forest and Conservation Nursery Association [Region F] provided the following clarification (*information was provided by the four largest users of MB/Pic 98:2 in the Association and by the contract applicator of methyl bromide for these nurseries. Observations reported from these users were made under operational conditions, not from research plots*):

Consortium members report that glyphosate is not a particularly effective herbicide for nutsedge control. Also, it can only be used during the fallow part of the nursery production cycle; and unless it is used with glyphosate-resistant cover crops, which are limited in number, it must be used on bare ground. Since the cover crop used during the fallow cycle serves to add organic matter to the soil, bare ground fallow will prevent the addition of organic matter to the nursery soil during this period.

The consortium currently has no additional information on the effectiveness of other Pic+ formulations mentioned by the MBTOC. However, one nursery is planning to apply a 2-acre trial of Pic Plus starting this fall.

The consortium does not know of any commercial applicators in their region that have the capability of applying fumigation treatments with VIF in broadacre applications, so this option is currently unavailable for their use.

The commercial applicator of methyl bromide used by the consortium nurseries reports that there is no manufacturer of VIF in the U.S., so this product must be imported from Europe. This applicator reports that the cost of VIF is currently about double the cost of the 1.0 mil polyethylene sheeting used for broadacre MB applications by consortium nurseries.

Weyerhaeuser Company [Region D] provided the following clarification (also, see Appendix A for a summary of Weyerhaeuser research studies pertinent to the MB nomination):

Weed control is secondary benefit of soil fumigation, with the primary effect being to maintain and manage soil pathogens over crop rotation cycles. Periodically, infestations of noxious weeds such as nutsedge need attention. Some facilities are required by specific State law to maintain a "nutsedge-free" growing environment, and crops can be put in quarantine if the weed nuts can be found in association with seedlings going to the forest.

Herbicide use in conifer nursery facilities is curtailed by EPA registration. Few currently registered herbicides can be used effectively on existing populations of nutsedge. This becomes more difficult when nutsedge infests currently growing seedlings, because few herbicides are safe to use on pine or fir seedlings.

Herbicides like TELAM, which have been used effectively in agriculture settings with fumigants (Metam) to control nutsedge are not currently registered for use on conifers. We have undertaken the first step in this evaluation process by securing a experimental use permit to test the phytotoxicity of this herbicide on loblolly pine. This test was completed in 2004, and its further testing does not appear to be restricted by phytotoxicity. Tests like this are dependent on state pesticide restrictions and regulations.

Other herbicides, such as Goal and Roundup (Glyphosate) are used routinely to control nursery weeds, either pre or post fumigation, but not simultaneously. We have one documented situation where Glyphosate applied 30 days prior to transplant in a bare-fallow field (non-fumigated field) might have contributed to excessive levels of mortality by the pathogen, *Cylindrocarpon*. There is some disagreement in the literature on the rate of breakdown and movement of Glyphosate after application, but less so on the ability of this herbicide to reduce plant defensive mechanisms.

We maintain an active cooperative research role with both the Western and Southern Nursery Cooperatives to study, test, and register new herbicides for nursery use. There is a high likelihood that this research in combination with our effective soil pathogen monitoring and management program will result in effect alternative soil treatment combinations.

Question 20. The Party states that substrates cannot be used for Region H because roots will freeze, but clarification is required on whether this could be avoided by use of polyethylene tunnels or in greenhouses where plug plants are raised successfully for many crops in many regions (Styter and Koranski, 1997).

Note: As the herbaceous seedlings portion of the nomination (region H) has more similarities to the Ornamentals sector than to Forest Seedlings, it is suggested that this nomination could be included in the Ornamentals CUN. Is this possible in future nominations?

ANSWER:
The Party agrees that plug plants can be raised under plastic or glass for "many crops, in many regions". However, in this case, the applicant has considered this option and determined that this technology would not be economically feasible for herbaceous perennials in Michigan. Therefore, the nomination for the 2007 is critical. The economic analysis (see attached economic worksheets, Appendix B) concludes that transitioning to covered production would require such a large pre-production investment there would be an unacceptable burden to growers. This analysis did not include additional building costs that would be associated with greenhouse construction. The Party contends that the applicant already uses alternatives for most of its production and has requested only an amount of MB (for 12 ha) that is critically necessary for use in 2007. These 12 hectares are a significant reduction from the 35 hectares treated in 2003, and from an average 128 ha treated in 2001/2002. Furthermore, multi-season field studies conducted by Michigan State University researchers will be completed and analyzed in 2007. Results of these studies should help identify options for further reductions in MB use, while maintaining production requirements.

Note: Future applications by this nominee will be included in the Ornamentals CUN.

V. Nursery stock(fruit trees, raspberries, roses):

Question 21. MBTOC is awaiting a revised nomination and BUNI to be submitted.

ANSWER: A revised BUNI has been attached. Please see Appendix III

VI. Orchard Replant:

Question 22. In bilateral discussions with the Party on April 13, 2005, the Party indicated it needed to further check calculations in all nominations in which strip treatments are used: This nomination indicates strip treatments are used for stone fruit and for almond. MBTOC awaits the confirmation of the calculations in order to complete this evaluation.

ANSWER: USG has confirmed that the treated area estimates have been adjusted to account for the strip bed treatments that are used for stone fruits. Specifically, the requested hectares were multiplied by 0.65 to account for the fact that only the strips are treated.

VII. Peppers:

Question 23. In SE US, Georgia and Florida, nematodes, soilborne fungi and nutsedge are key pests. The Party states that 1,3-D + chloropicrin + trifluralin + napropamide is the best alternative strategy, but further testing required. This is restricted to areas without karst topography and the Party states that several large scale trials are in progress. The Party is requested to provide details and results of these trials.

ANSWER

The researchers in these states are actively conducting research on alternatives. However, these are multiyear studies and the results are not yet available. For example, as described in Question 15 above, in the multiyear study by Gilreath, Santos, Motis, Noling and Mirusso (2005) looking at nematode and *Cyperus* control in bell pepper (*Capsicum annum*). In that study the author's state "For *Cyperus*, the herbicides failed to improve control, although in one season napropamide and trifluralin showed some activity." "For bell pepper yield, the application of metam sodium and metam sodium + chloropicrin provided similar fruit weight as for methyl bromide + chloropicrin in two of the three seasons." In that one year (Fall 2002) the yields went from 18.8 t/ha for methyl bromide + chloropicrin to 13.7 t/ha for metam sodium + chloropicrin or a 27% drop in yield. This level of yield loss could have severe economic impacts for a grower. Because of the inconsistency of some of the alternative treatments the U.S. does not consider them to be a replacement for methyl bromide. When highly trained, careful researchers see this level of variability it clearly demonstrates the need for multi-year studies to validate alternatives. Until those multi-year results are available accurate interpretation of the results is impossible.

Question 24. The CUN was based on limited research results, and MBTOC seeks further discussion on recent trial results in SE USA, especially those using low permeability barrier films (Gilreath et al 2005a) and new application methods for alternatives on peppers. Recent references available to MBTOC, demonstrate effective alternatives (metham sodium, with and without Pic) for moderate to heavy nutgrass control in similar regions to the nomination and for non karst and karst areas (Johnson and Webster, 2001 ;Gilreath et al 2005b,c): Yields were similar to methyl bromide, however there was no data presented on plantback effects for peppers. Party is requested to clarify the relevance of these results to the nomination.

ANSWER

Several members of MBTOC and the USG were recently able to tour field research sites in Florida and Georgia including the plots of Dr. Gilreath. During those discussions and in his recent research publications (Gilreath et al 2005, Gilreath et al in press, and Gilreath & Gilreath 2005) improved pest control when using virtually impermeable film (VIF) or metalized films (using an aluminum layer such as Canslit) was described. Dr. Gilreath and other researchers were contacted on the topics of low permeability barrier films, and newer application techniques. Based on their input it appears that VIF films have still not been widely adopted because of problems in: laying the films, inelasticity and the resultant difficulty in conforming to the bed shape, problems with linear shear, and the fact that embossed films are not available. The current versions of metalized films are being widely tested by several researchers and growers and they have the potential to reduce fumigant use rates with better laying and bedshape conforming characteristics. It is anticipated that the results of many of these research plots and growers field tests will be available next year. These metalized films pose several questions for adoption: the fate of the aluminum coating if it "flakes off" on the soil during removal and the photostability of the coating during multiple crop cycles as is common in the southeastern U.S. An additional concern with all of the low permeability films and reduced use rates is poor uniformity of treatment, unless the application equipment is redesigned to accommodate reduced flow rates and pressure (Gilreath and Gilreath 2005). While all of these results are promising there are only a few researchers that have multi-year trials with these films and new or modified application equipment. Many growers are said to be testing the new films, reduced rates of methyl bromide, and other alternatives. Without multi-year trials under a range of environmental conditions the consistency, feasibility, and adaptability cannot be assessed.

When evaluating research cited by MBTOC (Gilreath et al 2003) the untreated control at the Bradenton site had 53 nutsedge (*Cyperus rotundus*) plants per square yard, while the Immokalee site had fewer than one plant per square yard. The current standard that the U.S. recommends for moderate nutsedge pressure is 5 to 30 plants per square yard. At the Bradenton site the nutsedge control was not significantly different between MeBr: Pic (350 lb per acre) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) but had 39% more nutsedge plants and a 17% reduction in yield. When comparing the same treatments at Immokalee, which had and no significant difference in *Fusarium*, or nematodes (such as *Meloidogyne* spp, *Belonolainus* spp. *and Tylenchorhynchus* spp.), but low nutsedge pressure (<1 plant per square yard), there was still a 12.5% reduction in yield compared to methyl bromide.

Researchers in Georgia have also been conducting research on methyl bromide alternatives for pepper production (Culpepper, Webster, Langston 2005) and the interaction of VIF and LDPE films. Their research presented in the following four Tables shows promising results from VIF mulch versus LDPE but some early trends are apparent. Telone II or C35 followed by chloropicrin may lead to more injury when using VIF rather than LDPE, nutsedge visual estimate of control and the number of plants penetrating the mulch was generally better with VIF than LDPE, pepper yield (number of fancy fruit and weight or fancy or total fruit) did not appear to be effected by the type of mulch. When this type of study is repeated we hope to have a better understanding of the seasonal variability in pest control and harvest yield when using different types of mulches.

Table 16. Pepper response to various fumigant-mulch treatments in fall 2004.*

Fumigants**	Rates (broadcast rate)	Visual injury (45 day after planting)		Pepper height (30 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
Telone II fb chloropicrin	12 G fb 150 lbs	3	12	18	17
Telone C35 fb chloropicrin	35 G fb 150 lbs	2	15	17	15^
Telone II fb KPAM	12 G fb 60 G	6	6	18	17
None		0	0	17	15^
Methyl bromide + chloropicrin (67:33)	400 lbs	2	3	17	18
Methyl iodide + chloropicrin (50:50)	400 lbs	2	73^	17	11^
Dimethyldisulfide	800 lbs	0	2	19	17
Dimethyldisulfide + chloropicrin (50:50)	700 lbs	0	18^	18	14^

*Means within crop injury (plant stunting) can be compared with an LSD = 8 while plant heights can be compared with an LSD = 2. Fumigants were applied on July 20 and the crop was planted on August 2.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per 32 inch bedtop. Kapam was injected into the soil with blades 4.5 inches apart. KPAM was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch within each variable.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 17. Nutsedge response to various fumigant-mulch treatments in pepper during the fall of 2004.*

Fumigants**	Rates (broadcast rate)	Visual control (95 days after fumigating)		Number plants penetrating mulch (95 days after fumigating)	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
Telone II fb chloropicrin	12 G fb 150 lbs	17^	53^	140^	76^
Telone C35 fb chloropicrin	35 G fb 150 lbs	44^	90^	85^	21
Telone II fb KPAM	12 G fb 60 G	35^	43^	95^	118^
None		0^	0^	126^	116^
Methyl bromide + chloropicrin (67:33)	400 lbs	75	87^	47	22

Methyl iodide + chloropicrin (50:50)	400 lbs	32^	70	96^	36
Dimethyldisulfide	800 lbs	5^	13^	156^	140^
Dimethyldisulfide + chloropicrin (50:50)	700 lbs	12^	87^	154^	38

*Means within visual nutsedge control can be compared with an LSD = 6 while the number of nutsedge plants penetrating the mulch over the entire 20 foot plot can be compared with an LSD = 28. Fumigants were applied on July 20 and the crop was planted on August 2.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per 32 inch bedtop. Kpam was injected into the soil with blades 4.5 inches apart. KPAM was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch at plant date 1.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 18. Number of pepper in various fumigant-mulch treatments harvested in fall 2004.*

Fumigants**	Rates (broadcast rate)	Number of fancy fruit (harvest 1 only)		Number of fancy fruit from harvest 1, 2, and 3	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
Telone II fb chloropicrin	12 G fb 150 lbs	10^	14	70	86
Telone C35 fb chloropicrin	35 G fb 150 lbs	11^	14	83	74
Telone II fb KPAM	12 G fb 60 G	13	18	72	81
None		4^	8^	32	53^
Methyl bromide + chloropicrin (67:33)	400 lbs	18	22	84	88
Methyl iodide + chloropicrin (50:50)	400 lbs	14	1^	72	46^
Dimethyldisulfide	800 lbs	2^	18	43^	82
Dimethyldisulfide + chloropicrin (50:50)	700 lbs	11^	12	63^	75

*Means within the first harvest only can be compared using an LSD = 7 while the number of fancy fruit harvested over the first three harvest dates can be compared using an LSD = 17. Harvest sample size was 20 row feet of pepper. Fumigants were applied on July 20 and crop was planted on August 2.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per 32 inch bedtop. Vapam was injected into the soil with blades 4.5 inches apart. KPAM was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch within each variable.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Table 19. Weight of pepper (lbs) in various fumigant-mulch treatments harvested in fall 2004.*

Fumigants**	Rates (broadcast rate)	Weight (lbs) of fancy fruit (harvest 1 only)		Total weight (lbs) of fruit from harvest 1, 2, and 3	
		LDPE mulch	VIF mulch	LDPE mulch	VIF mulch
Telone II fb chloropicrin	12 G fb 150 lbs	4^	6	31^	37
Telone C35 fb chloropicrin	35 G fb 150 lbs	5^	5^	37	33
Telone II fb KPAM	12 G fb 60 G	5^	7	32	35
None		2	3^	14^	23^
Methyl bromide + chloropicrin (67:33)	400 lbs	8	9	38	39
Methyl iodide + chloropicrin (50:50)	400 lbs	6	0^	32	22^
Dimethyldisulfide	800 lbs	1^	8	19^	37
Dimethyldisulfide + chloropicrin (50:50)	700 lbs	5^	5^	28^	32

*Means within harvest date 1can be compared with an LSD = 3 while the weight of fancy fruit harvested over the first three harvest dates can be compared with an LSD = 7. Harvest sample size was 20 row feet of pepper. Fumigants were applied on July 20 and crop was planted on August 2.

**DMDS, methyl bromide, chloropicrin, Telone C35, and methyl iodide were applied with a normal methyl bromide application apparatus applying fumigants 6 to 8 inches deep using 3 injecting knives per 32 inch bedtop. Kpam was injected into the soil with blades 4.5 inches apart. KPAM was applied as a broadcast treatment and then pulled into the bed where all other treatments were applied only in the bed.

^Values differ from methyl bromide under LDPE mulch within each variable.

From: A.S. Culpepper, T.M. Webster, D. Langston, Univ. of Georgia, August 15, 2005 E-mail from W.T. Kelley.

Question 25. MBTOC also requests the Party provide the registration status and use rates available for use with MB/Pic mixtures and verify that mixtures with less MB (especially 30:70, 50:50)are unsuitable for control of the key pests in the nomination. Also it is requested that economic data be provided for the two most appropriate alternatives for all circumstances of the nomination.

ANSWER

Communications with several researchers indicated that they have started, or are about to initiate, studies to look at long term performance of even lower rates of methyl bromide (at or below 200 kg/ha). These studies will encompass a wide range of environmental conditions, pest pressure, soil types, etc. and help to demonstrate consistency of control. IF MBTOC has references indicating the use of 50:50 or 30:70 is effective in the circumstances of the US nomination we would like to have those citations.

One of the studies that MBTOC cites is from Florida (Gilreath et al, 2005a), which looked at the impact of reduced rates of MB on pest control and pepper yield. In that study, which had high *Cyperus* spp. pressure, there were no significant differences in yield between any of the rates of methyl bromide with the different types of films. However, an examination of the change in yield with VIF treatments, compared to the standard MB treatments, suggests significant variability within treatments, which led to the lack of statistical significance in yield despite the large numerical differences in yield between treatments. Trials such as those conducted by Gilreath et al (2005a) with peppers, need to be conducted over several seasons, and preferably with different crops. The reality of the use of VIF for the 2007 season is its current prohibitive cost in the U.S., and even more significant, its lack of availability for use on a commercial scale. The Party does not anticipate these issues can be adequately resolved before the critical use season of 2007.

Table 20. Pepper yield are not significantly different but percent yield loss can be large.

	Treatment	Application Rate kg/ha	Yield t/ha	% Change
1	Untreated		9.5	-31%
2	MeBr + Pic LDPE	392	13.8	0%
3	MeBr + Pic VIFP	196	10.8	-22%
4	MeBr + Pic VIFP	98	13.6	1%
5	MeBr + Pic VIFV	196	11.4	-17%
6	MeBr + Pic VIFV	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287.
LDPE is low density polyethylene, VIFP and VIFV are virtually impermeable film by Plastopil and Vikase respectively.

The research plots that MBTOC visited in Florida clearly demonstrated that chloropicrin will not control sedges such as *Cyperus esculentus* or *C. rotundus* . Research by Gilreath and communications with him indicate that chloropicrin enhances nutsedge germination (this research has yet to be repeated for other pest species). Therefore, increasing the amount of chloropicrin applied can increase pest pressure and yield loss.

The economic information was presented in the sector chapter for peppers and is reproduced below:

Part E: Economic Assessment

Economic data from the 2004 submission for all applicants were not substantially different from those in 2003 (greater or less than a 10% change in costs and revenue). Given these insignificant differences, the economic analyses were not updated for any applicants other than Michigan, which was updated to reflect a change in the requested pounds of MeBr.

The following economic assessment is organized by MeBr critical use application. Cost of MeBr and alternatives are given first in table 21.1. This is followed in table 22.1 by a listing of net and gross revenues by applicant. Expected losses when using MeBr alternatives are then further decomposed in tables E1 through E5.

Reader please note that in this study net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this study. We did not include fixed costs because it is often difficult to measure and verify.

21. Operating Costs of Alternatives Compared to Methyl Bromide Over 3-Year Period:

TABLE 21.1: PEPPERS – OPERATING COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

Alternative	Yield*	Cost in year 1 (US$/ha)	Cost in year 2 (US$/ha)	Cost in year 3 (US$/ha)
California				
Methyl Bromide	100%	$17,246	$17,246	$17,246
1,3-D + Chloropicrin	94%	$17,160	$17,160	$17,160
Florida				
Methyl Bromide	100%	$20,341	$20,341	$20,341
1,3-D + Chloropicrin	71%	$18,510	$18,510	$18,510
Metam-Sodium	56%	$16,999	$16,999	$16,999
Georgia				
Methyl Bromide	100%	$28,623	$28,623	$28,623
1,3-D + Chloropicrin	71%	$25,790	$25,790	$25,790
Metam-Sodium	56%	$23,598	$23,598	$23,598
Michigan				
Methyl Bromide	100%	$23,938	$23,938	$23,938
1,3-D + Chloropicrin	94%	$25,607	$25,607	$25,607
Southeast USA				
Methyl Bromide	100%	$18,758	$18,758	$18,758
1,3-D + Chloropicrin	71%	$18,844	$18,844	$18,844
Metam-Sodium	56%	$16,731	$16,731	$16,731

* As percentage of typical or 3-year average yield, compared to methyl bromide e.g. 10% more yield, write 110.

22. Gross and Net Revenue:

TABLE 22.1: PEPPERS – YEAR 1, 2, AND 3 GROSS AND NET REVENUES

YEAR 1, 2, AND 3		
ALTERNATIVES (as shown in question 21)	GROSS REVENUE FOR LAST REPORTED YEAR (US$/ha)	NET REVENUE FOR LAST REPORTED YEAR (US$/ha)
California		
Methyl Bromide	$21,344	$4,098
1,3-D + Chloropicrin	$20,063	$2,903
Florida		
Methyl Bromide	$29,498	$9,158
1,3-D + Chloropicrin	$20,944	$2,433
Metam-Sodium	$16,519	$(479)
Georgia		
Methyl Bromide	$35,176	$6,553
1,3-D + Chloropicrin	$24,975	$(816)
Metam-Sodium	$19,698	$(3,900)
Michigan		
Methyl Bromide	$24,056	$118
1,3-D + Chloropicrin	$20,916	$(2,994)
Southeastern USA		
Methyl Bromide	$30,579	$11,822
1,3-D + Chloropicrin	$21,711	$2,867
Metam-Sodium	$17,124	$393

NOTE: Year 1 equals year 2 and 3.

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA PEPPER - TABLE E1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	787	739
* PRICE PER UNIT (US$)	$27	$27
= GROSS REVENUE PER HECTARE (US$)	$21,344	$20,063
- OPERATING COSTS PER HECTARE (US$)	$17,246	$17,160
= NET REVENUE PER HECTARE (US$)	$4,098	$2,903
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$1,194
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$8
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	6%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	29%
5. PROFIT MARGIN (%)	19%	14%

FLORIDA PEPPER - TABLE E.2: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

FLORIDA PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	2,922	2,074	1,636
* PRICE PER UNIT (US$)	$10	$10	$10
= GROSS REVENUE PER HECTARE (US$)	$29,498	$20,944	$16,519
- OPERATING COSTS PER HECTARE (US$)	$20,341	$18,510	$16,999
= NET REVENUE PER HECTARE (US$)	$9,158	$2,433	$(479)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$6,724	$9,637
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$45	$64
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	23%	33%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	73%	105%

5. PROFIT MARGIN (%)	31%	12%	-3%

GEORGIA PEPPER - TABLE E.3: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

GEORGIA PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	4,440	3,152	2,486
* PRICE PER UNIT (US$)	$8	$8	$8
= GROSS REVENUE PER HECTARE (US$)	$35,176	$24,975	$19,698
- OPERATING COSTS PER HECTARE (US$)	$28,623	$25,790	$23,598
= NET REVENUE PER HECTARE (US$)	$6,553	$(816)	$(3,900)
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$7,368	$10,453
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$49	$70
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	21%	30%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	112%	160%
5. PROFIT MARGIN (%)	19%	-3%	-20%

MICHIGAN PEPPER- TABLE E.4: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MICHIGAN PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN
YIELD LOSS (%)	0%	6%
YIELD PER HECTARE	4,530	4,258
* PRICE PER UNIT (US$)	$5	$5
= GROSS REVENUE PER HECTARE (US$)	$24,056	$20,916
- OPERATING COSTS PER HECTARE (US$)	$23,938	$25,607
= NET REVENUE PER HECTARE (US$)	$118	$(4,690)
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$0	$4,808
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$40
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	20%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	100%
5. PROFIT MARGIN (%)	0%	-22%

SOUTHEASTERN USA (EXCEPT GEORGIA) PEPPER - TABLE E.5: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEASTERN USA (EXCEPT GEORGIA) PEPPER	METHYL BROMIDE	1, 3-D + CHLOROPICRIN	METAM-SODIUM
YIELD LOSS (%)	0%	29%	44%
YIELD PER HECTARE	3,707	2,632	2,076
* PRICE PER UNIT (US$)	$8	$8	$8
= GROSS REVENUE PER HECTARE (US$)	$30,579	$21,711	$17,124
- OPERATING COSTS PER HECTARE (US$)	$18,758	$18,844	$16,731
= NET REVENUE PER HECTARE (US$)	$11,822	$2,867	$393
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$0	$8,954	$11,429
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$0	$60	$76
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	29%	37%
4. LOSS AS A PERCENTAGE OF NET REVENUE (%)	0%	76%	97%
5. PROFIT MARGIN (%)	39%	13%	2%

Summary of Economic Feasibility

There are currently few alternatives to methyl bromide for use in peppers. Furthermore, there are factors that limit existing alternatives' usability and efficacy from place to place. These include pest complex, climate, and regulatory restrictions. As described above, the two most promising alternatives to methyl bromide in Florida, Georgia, and the Southeastern USA for control of nut-sedge in peppers (1,3-D + chloropicrin and metam-sodium) are considered not technically feasible. This derives from regulatory restrictions and the magnitude of expected yield losses when they are used. Economic data representing the Florida, Georgia, and Southeastern USA pepper growing conditions are included in this section as a supplement to the biological review to illustrate the impacts of using MeBr alternatives, not to gauge them with respect to economic feasibility. However, in California and Michigan 1,3-D + chloropicrin is considered technically feasible.

California

Yield loss in California pepper production is expected to be 6% when using MeBr alternatives. Growers will experience loss on a per hectare basis of approximately $1,200 and 6% and 29% losses in gross and net revenues, respectively. However, these measures do not clearly indicate that 1,3-D + chloropicrin is an economically infeasible alternative to MeBr.

The economic conditions facing pepper growers were quantified as best as possible but, primarily due to limited data availability, every aspect of the economic picture was not included in the numeric assessment. Factors not accounted for are distribution of yield loss across individual growers and the yield risk associated with using MeBr alternatives.

Michigan

The US concludes that, at present, no economically feasible alternatives to MeBr exist for use in Michigan pepper production. Two factors have proven most important in this conclusion. These are yield loss and missed market windows, which are discussed individually below.

1. Yield Loss

Expected yield losses of 6% are anticipated throughout Michigan pepper production.

2. Missed Market Windows

The US agrees with Michigan's assertion that growers will likely receive significantly lower prices for their produce if they switch to 1,3-D + chloropicrin. This is due to changes in the harvest schedule caused by the above described soil temperature complications and extended plant back intervals when using 1,3-D + chloropicrin.

The analysis of this effect is based on the fact that prices farmers receive for their peppers vary widely over the course of the growing season. Driving these fluctuations are the forces of supply and demand. Early in the growing season, when relatively few peppers are harvested, the supply is at is lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, pepper growers manage their production systems with the goal of harvesting the largest possible quantity of peppers when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of pepper operations.

To describe these conditions in Michigan pepper production, weekly pepper sales data from the US Department of Agriculture for the previous three years was used to gauge the impact of early season price fluctuations on gross revenues. Though data availability is limiting, it is assumed that if pepper growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin, that they will, over the course of the growing season, receive gross revenues reduced by approximately 7.5%. The season average price was reduced by 7.5% in the analysis of the alternatives to reflect this. Based on currently available information, the US believes this reduction in gross revenues serves as a reasonable indicator of the typical effect of planting delays resulting when MeBr alternatives are used in Michigan pepper production.

Florida

No technically (and thus economically) feasible alternatives to MeBr are presently available to the effected pepper growers. As such, the US concludes that use of MeBr is critical in Florida pepper production.

Georgia

No technically (and thus economically) feasible alternatives to MeBr are presently available to the effected pepper growers. As such, the US concludes that use of MeBr is critical in Georgia pepper production.

Southeastern USA Except Georgia

No technically (and thus economically) feasible alternatives to MeBr are presently available to the effected pepper growers. As such, the US concludes that use of MeBr is critical in Southeastern USA pepper production.

Question 26. There appears to be scope for substantial reduction in MB use in this area through adoption of barrier film technology together with reduced MB dosages. Party is requested to clarify why low permeability barrier films cannot be used in SE USA based on results from recent studies and publications from trials conducted from 1998 to 2005.

ANSWER:
Several members of MBTOC and the USG were recently able to tour field research sites in Florida and Georgia, including the plots of Dr. Gilreath. In those discussions, and in his recent research publications (Gilreath et al 2005, Gilreath et al in press, and Gilreath & Gilreath 2005), the improved pest control using virtually impermeable film (VIF) or metalized films (using an aluminum layer such as Canslit) was described. Dr. Gilreath and other researchers were contacted on the topics of low permeability barrier films, and newer application techniques. Based on their input it appears that VIF films have still not been widely adopted because of problems in: laying the films, inelasticity and the resultant difficulty in conforming to the bed shape, problems with linear shear, and the fact that embossed films are not available. The current versions of metalized films are being widely tested by several researchers and growers and they have the potential to reduce fumigant use rates with better laying and bedshape conforming characteristics. It is anticipated that the results of many of these research plots and growers field tests will be available next year. These metalized films pose several questions for adoption of these films: the fate of the aluminum coating if it "flakes off" on the soil during removal and the photostability of the coating during multiple crop cycles as is common in the southeastern U.S. An additional concern with all of the low permeability films and reduced use rates is poor uniformity of treatment unless the application equipment must be redesigned to accommodate reduced flow rates and pressure (Gilreath and Gilreath 2005). While all of these results are promising there are only a few researchers that have multi-year trials with these films and new or modified application equipment. Many growers are said to be testing the new films, reduced rates of methyl bromide, and other alternatives. Without multi-year trials under a range of environmental conditions the consistency, feasibility, and adaptability cannot be assessed.

When evaluating research cited by MBTOC (Gilreath et al, 2003) the untreated control at the Bradenton site had 53 nutsedge (*Cyperus rotundus*) plants per square yard, while the Immokalee site had fewer than one plant per square yard. The current standard that the US recommends for moderate nutsedge pressure is 5 to 30 plants per square yard. At the Bradenton site the nutsedge control was not significantly different between MeBr:Pic (350 lb per acre) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) but had 39% more nutsedge plants and a 17% reduction in yield. When comparing the same treatments at Immokalee, which had and no significant difference in *Fusarium*, or nematodes (such as *Meloidogyne* spp, *Belonolainus* spp*. and Tylenchorhynchus* spp.), but low nutsedge pressure (<1 plant per square yard), there was still a 12.5% reduction in yield compared to methyl bromide.

VIII. STRAWBERRY FRUIT

Question 27. In California, the nomination is based on the grounds that township caps limit further adoption of 1,3-D, and hilly terrain prevents the use of drip-applied alternatives. In the case of township caps, alternatives that do not contain 1,3-D (such as Pic and Pic + metham applied sequentially) are technically feasible in at least part of this area (Ajwa et a12002, 2004), Party to describe why these alternatives proven in recent studies are not feasible for a proportion of the nomination.

ANSWER:
The Party agrees that some research has shown that alternatives such as chloropicrin and metham sodium might offer effective pest management possibilities to strawberry farmers. However, the reality in the field is that for such a high value crop, potential alternatives to MB must be proven on a larger scale than has been done thus far. Efforts to identify risks of alternatives, such as off-gassing accidents that can devastate crops, are actively being pursued by farmers, researchers and extension workers. For the 2007 growing season, however, the Party maintains that the nomination for MB for this sector is critical. The California Strawberry Commission provided the following to address MBTOC's concerns:

Straight Pic and Pic + metam sodium sequential treatments are used in a small proportion of the strawberry acreage due to a combination of efficacy, regulatory and production system limitations. A review of the 2003 PUR [California Pesticide Use Report] data from Cal DPR [California Department of Pesticide Regulation] reveals that only 902.5 acres [366 ha] were treated with metam sodium compared to 26,480 acres [10,722 ha] treated with Pic combinations. This represents only 3% of the acreage with several counties showing 0 acres treated. Many County Ag Commissions discourage or prohibit metam sodium applications through strict permit conditions, the result of several fumigation accidents in the past. Currently in many counties 500 foot buffers are required around metam sodium treated fields which causes many fields to be unsuitable candidates for this fumigant. The use of Pic + metam applications was primarily restricted to Orange County with some use other Counties (see Table 1). The main production issue with using metam is the need for an extended plant back time that lengthens the time needed to prepare the field for planting by up to 2 weeks. Pic alone applications have been shown to be less efficacious than methyl bromide + Pic, Telone + Pic or Pic + metam sodium. In the northern districts, where 50% (Santa Maria) to 90% (Monterey/Watsonville) of the acreage is planted to day-neutral cultivars, drip fumigation presents significant transitional issues due to the need to switch from broadcast to bed fumigation. This requires a significant increase in setup time for growers prior to fumigation and results in a loss of revenue from a vegetable crop not being able to be grown in rotation with the strawberry crop. Recent research suggests that Pic + high barrier films may prove to be a viable alternative. The California Strawberry Commission is conducting research to verify these results and working with the regulators to allow increased use of straight Pic applications.

Table 21. Pesticide use data for major strawberry production regions in California, 2003 (California Department of Pesticide Regulation database).

County	Methyl Bromide	Chloropicrin	1,3-D	Metam Sodium	Pic only (= Pic -MB - 1,3-D)*
	Hectares treated with fumigant				
San Diego	188	230	7	0	34
Orange	365	676	25	38	286
Ventura	3003	3467	348	301	116
Santa Barbara	923	1665	672	24	70
San Luis Obispo	17	256	238	0	1
Monterey	2662	3317	596	0	59
Santa Cruz	1006	1111	115	3	-10
total	8164	10722	2001	366	556
% of total (Pic)	76%	100%	19%	3%	

*negative values are due to recording errors in California Department of Pesticide Regulation database

Question 28. The CUN noted that producers of day-neutral cultivars like Diamonte could miss early market windows due to longer equipment set-up time for drip application and/or reduced harvest period, However, the Party noted that this is not a serious problem for short day cultivars, such as Camaresa. MBTOC notes that chloropicrin alone and chloropicrin mixtures are being adopted for strawberry fruit, particularly in the south, where short day cultivars are grown (PUR data cited in Trout and Damodaran 2004; California Strawberry Commission 2005). The Party is requested to clarify the scope for additional adoption of chloropicrin and/or chloropicrin ÷ metham for short day. cultivars.

ANSWER:

While Northern California growers of short day strawberry varieties have some latitude in planting dates, yield of short day cultivars planted in the southeastern U. S. are dependent on proper time of planting. Therefore, the MB nomination for this sector is critical for the 2007 growing season. Without MB, high rates of chloropicrin would extend the plant-back time, which is critical in key strawberry-growing regions (Hamill et al 2004)**.**

The Southeastern Strawberry Consortium addressed the issue of the importance of timing of plant-back for their industry (http://www.smallfruits.org/Strawberries/production/2003SEstrawberryNarrativeFinal.pdf):

Upper Coastal Plain and Lower Central Piedmont strawberry acreage in North Carolina **must** be planted from 25-Sept to 1-Oct for growers in this area to achieve the kinds of yields that we are representing…(20,600 lb/A) [23,100 kg/ha]. Outsiders to our industry are often surprised to learn that even an extra week of delay in planting for the popular 'short day' type strawberry cultivars Chandler, Camarosa and Sweet Charlie, can result in reductions in yield potential of 15-20%, or more. A two week delay could potentially reduce yields by 50%, especially in a colder than normal fall and winter conditions, such as the in 2000-2001 season. In fact, at the Clayton Central Crops Research Station (Upper Coastal Plain) in a 2002-2003 strawberry plasticulture fumigation study involving Telone C-35 at 30 gal/A [278 L/ha], iodomethane 98:2 at 150 lb/A [168 kg/ha] and iodomethane 98:2 at 120 lb/A [135 kg/ha], it was learned that by planting on 27-Sep-02 we achieved an overall marketable yield of 21,791 lb/A [24,436 kg/ha] vs. 17,492 [19,615 kg/ha] for 4-Oct-02 and 10,287 lb/A [11,536 kg/ha] for planting on 11-Oct-02 (averaged over all 3 fumigants). This represents an actual reduction in yield of nearly 20% for a 1-week delay and 52% for a 2-week delay for Chandler fruit harvested in April-May 2003 (unpublished report –Poling and Schiavone). In addition, iodomethane at 150 lb/A [168 kg/ha] (75 lb/A in the bed) [84 kg/ha] produced a statistically significant higher yield than Telone C-35, and was statistically no different than the 120 lb/A [135 kg/ha] rate (Iodomethane 98:2) – suggesting some important cost savings are possible with shank injection of this fumigant. The anticipated label for Iodomethane 98:2 will permit a 1 week plant-back…At this stage, only MBC-33 (2 week plant-back), or iodomethane 98:2 (1 week plant-back – assuming that this product receives EPA registration in Sep-03) [it did not] will permit growers to achieve a timely planting, assuming that the fumigation is completed in mid-September.

The California Strawberry Commission provided the following clarification:

The California Strawberry Commission is working aggressively to verify the suitability of Pic + high barrier films and overcome regulatory barriers to the use of straight Pic applications. The key to improving local permit conditions for the use of Pic may be through reduced emissions. If Pic can be retained within the treated bed for sufficiently long it will degrade (2 day half life), dramatically reducing emissions. Research on the use of high barrier films, salt/water furrow seals and other technology is under consideration by the Commission and should prove helpful in obtaining more permissive local permit conditions for using Pic and other alternatives. The same methods should be useful in reducing emissions of Telone, leading to a significant increase in the amount of acres that can be treated with Telone within the township cap restrictions.

Question 29. Regarding hilly terrain, MBTOC acknowledges that current methods of drip application may not be appropriate. MBTOC is aware that pressure, compensated drip application systems are used in parts of the world, and requests if there are any issues affecting their adoption on some parts of the hilly terrain,

ANSWER

Because the technology for this problem has not been fully field-tested, MB will be critical for the 2007 season. The California Strawberry Commission provided the following clarification to MBTOC:

This represents an increase in cost and the adaptation of new technology that requires transitional time. There are questions about the effectiveness of such systems. We will further investigate this option with Dr. Tom Trout who has an extensive understanding of the drip irrigation systems used on strawberry in California."

Question 30. MBTOC considers that alternatives appear to be available for some part of the buffer zones, which are not subject to heavy nutsedge pressure (e.g. Pic formulations metham + Pie), so is seeking further information about the potential area that could adopt such alternatives.

Answer:
Only a small portion of the buffer zone would be available for alternatives, and the MB use for this sector would not be effectively different than the 2007 nomination. According to experts at the Department of Horticulture, North Carolina State University: "There is a potential for use of both metham + Pic in approximately 10% of the buffer zones which are not subject to heavy nutsedge, and this option will be pursued by 1-2% of the growers in the Consortium in 2006 under the guidance of North Carolina State University researchers and Extension workers (under a grant from USDA). There is no opportunity to utilize Chloropicrin alone due to its poor control of any weeds."

Question 31. For Florida, the Party states that at moderate to severe pest pressure (primarily nutsedge on 30-40% of area), protocols for commercial application of alternatives have not been sufficiently developed to be implemented for the 2007 season. However no recent trial data was provided to MBTOC to substantiate the information. Please provide.

ANSWER:
The Party maintains that regulatory restrictions and technical feasibility prevent the implementation of alternatives in critical areas by strawberry farmers for the 2007 season. The use of 1,3-D is restricted as an alternative to MB in areas with karst geology. Maps showing areas of karst geology in Florida are available online
http://www.caves.com/fss/pages/misc/images/karst_map.gif,
http://www.dep.state.fl.us/geology/geologictopics/sinkhole.htm, and
(http://www2.nature.nps.gov/nckri/map/maps/engineering_aspects/davies_map_PDF.pdf). The proportion of the current Florida strawberry crop that should not use 1,3-D because of karst geology is not known exactly but appears to be high in the major strawberry-growing areas of Florida (see map). These areas are concentrated within a 40 km radius of Plant City, Florida on approximately 2,760 ha (2002 estimate; see Rosskopf et al., 2005) in an increasingly populated region between Tampa and Orlando. Much of this area sits on limestone at, or near, the surface (Rosskopf et al 2005) (http://www.caves.com/fss/pages/misc/images/karst_map.gif).

Another alternative, VIF tarp technology, is being actively researched. Recently, Noling and Gilreath (2004) reported on demonstration trials comprising 17 commercial strawberry fields that were conducted by growers from 2000-2004. Results of these trials allowed the evaluation of the use of VIF and its efficacy when used in combination with reduced rates of MB. Results were promising from a pest management perspective, but conclusions reached concerning the technical aspects of VIF are consistent with the Party's contention that for the 2007 season, MB is critical for strawberry farmers in Florida. According to Noling and Gilreath:

At many of the demonstration sites, problems were incurred during the plastic laying operation, in that tractor speeds needed to be reduced as low as 2 to 3 mph [3-5 kph], rather than 4 to 5 mph [6.4-8 kph], to properly install the plastic. Since the VIF plastics are not embossed, they have a tendency to slip from under the rear press wheels during installation causing stoppages in the plastic laying operation. Since the VIF mulch lack 'stretch' characteristics, utilizing marginally wider spool widths of plastic than typically used have improved laying characteristics in the field. There is also no question that these new VIF mulches will be more expensive (2x) in terms of material and labor costs to install It should also be recognized that these slower tractor speeds can also create a flow metering problem for accurate, uniform dispensing of methyl bromide; thereby requiring some possible changes in application equipment (Noling and Gilreath 2004).

IX. Tomatoes:

Question 32. The Party provided limited information on recent trials conducted in the US especially those using VIF films and new application methods for alternatives. MBTOC also requests the Party to review the use rates used with MB/Pic mixtures and verify that mixtures with less MB (especially 30:70 and 50:50)are unsuitable for control of the key pests in the nomination.

ANSWER:
Several members of MBTOC and the USG were recently able to tour field research sites in Florida and Georgia including the plots of Dr. Gilreath. During those discussions and in his recent research publications (Gilreath et al 2005, Gilreath et al in press, and Gilreath & Gilreath 2005) the improved pest control when using virtually impermeable film (VIF) or metalized films (using an aluminum layer such as Canslit) was described. Dr. Gilreath and other researchers were contacted on the topics of low permeability barrier films, and newer application techniques. Based on their input it appears that VIF films have still not been widely adopted because of problems in: laying the films, inelasticity and the resultant difficulty in conforming to the bed shape, problems with linear shear, and the fact that embossed films are not available. The current versions of metalized films are being widely tested by several researchers and growers and they have the potential to reduce fumigant use rates with better laying and bedshape conforming characteristics. It is anticipated that the results of many of these research plots and growers field tests will be available next year. These metalized films pose several questions for adoption: the fate of the aluminum coating if it "flakes off" on the soil during removal and the photostability of the coating during multiple crop cycles as is common in the southeastern U.S. An additional concern with all of the low permeability films and reduced use rates is poor uniformity of treatment unless the application equipment must be redesigned to accommodate reduced flow rates and pressure (Gilreath and Gilreath 2005). While all of these results are promising there are only a few researchers that have multi-year trials with these films and new or modified application equipment. Many growers are said to be testing the new films, reduced rates of methyl bromide, and other alternatives. Without multi-year trials under a range of environmental conditions the consistency, feasibility, and adaptability cannot be assessed.

When evaluating research cited by MBTOC (Gilreath et al, 2003) the untreated control at the Bradenton site had 53 nutsedge (*Cyperus rotundus*) plants per square yard, while the Immokalee site had fewer than one plant per square yard. The current standard that the US recommends for moderate nutsedge pressure is 5 to 30 plants per square yard. At the Bradenton site the nutsedge control was not significantly different between MeBr:Pic (350 lb per acre) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) but had 39% more nutsedge plants and a 17% reduction in yield. When comparing the same treatments at Immokalee, which had and no significant difference in *Fusarium*, or nematodes (such as *Meloidogyne* spp, *Belonolainus* spp. *and Tylenchorhynchus* spp.), but low nutsedge pressure (<1 plant per square yard), there was still a 12.5% reduction in yield compared to methyl bromide.

Question 33. Also it is requested that economic data be provided for the two most appropriate alternatives for all circumstances of the nomination.

ANSWER:

Those data were provided in the tomato sector report and are reproduced below:

Part E: Economic Assessment

The following economic analysis is organized by MeBr critical use application. Cost of MeBr and alternatives are given first in table 21.1. This is followed in table 22.1 by a listing of net and gross revenues by applicant. Expected losses when using MeBr alternatives are then decomposed in tables E1 through E3.

Reader please note that in this study net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this study. We did not include fixed costs because it is often difficult to measure and verify.

21. COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

TABLE 21.1: COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

REGION	ALTERNATIVE	YIELD*	COST IN YEAR 1 (US$/ha)	COST IN YEAR 2 (US$/ha)	COST IN YEAR 3 (US$/ha)
CALIFORNIA	Methyl Bromide	100	$ 50,240	$ 50,240	$ 50,240
	Metam Sodium	85	$ 46,353	$ 46,353	$ 46,353
	Metam Sodium	80	$ 44,626	$ 44,626	$ 44,626
MICHIGAN	Methyl Bromide	100	$ 30,559	$ 30,559	$ 30,559
	1,3–D + Chloropicrin	78	$ 29,555	$ 29,555	$ 29,555
	Metam Sodium	78	$ 29,739	$ 29,739	$ 29,739
	Chloropicrin	78	$ 29,555	$ 29,555	$ 29,555
SOUTHEASTERN US	Methyl Bromide	100	$ 26,380	$ 26,380	$ 26,380
	1,3–D + Chloropicrin	83	$ 24,946	$ 24,946	$ 24,946

* As percentage of typical or 3-year average yield, compared to methyl bromide e.g. 10% more yield, write 110.

22. Gross and Net Revenue:

TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

Year 1			
Region	Alternatives (as shown in question 21)	Gross revenue for last reported year (US$/ha)	Net Revenue for last reported year (US$/ha)
California	Methyl Bromide	$ 83,367	$ 33,127
	Metam Sodium (15%)	$ 70,862	$ 24,509
	Metam Sodium (20%)	$ 66,694	$ 22,068
Michigan	Methyl Bromide	$ 39,996	$ 9,438
	1,3–D + Chloropicrin	$ 32,880	$ 3,325
	Metam Sodium	$ 34,931	$ 5,192
	Chloropicrin	$ 32,880	$ 3,325
Southeastern US	Methyl Bromide	$ 40,914	$ 14,533
	1,3–D + Chloropicrin	$ 33,772	$ 8,825

TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

Year 2			
Region	Alternatives (as shown in question 21)	Gross revenue for last reported year (US$/ha)	Net Revenue for last reported year (US$/ha)
California	Methyl Bromide	$ 83,367	$ 33,127
	Metam Sodium (15%)	$ 70,862	$ 24,509
	Metam Sodium (20%)	$ 66,694	$ 22,068
Michigan	Methyl Bromide	$ 39,996	$ 9,438
	1,3–D + Chloropicrin	$ 32,880	$ 3,325
	Metam Sodium	$ 34,931	$ 5,192
	Chloropicrin	$ 32,880	$ 3,325
Southeastern US	Methyl Bromide	$ 40,914	$ 14,533
	1,3–D + Chloropicrin	$ 33,772	$ 8,825

TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

Year 3			
Region	Alternatives (as shown in question 21)	Gross revenue for last reported year (US$/ha)	Net Revenue for last reported year (US$/ha)
California	Methyl Bromide	$ 83,367	$ 33,127
	Metam Sodium (15%)	$ 70,862	$ 24,509
	Metam Sodium (20%)	$ 66,694	$ 22,068
Michigan	Methyl Bromide	$ 39,996	$ 9,438

	1,3–D + Chloropicrin	$ 32,880	$ 3,325
	Metam Sodium	$ 34,931	$ 5,192
	Chloropicrin	$ 32,880	$ 3,325
SOUTHEASTERN US	Methyl Bromide	$ 40,914	$ 14,533
	1,3–D + Chloropicrin	$ 33,772	$ 8,825

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA - TABLE E.1: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

CALIFORNIA	METHYL BROMIDE	METAM SODIUM	
PRODUCTION LOSS (%)	0%	15%	20%
PRODUCTION PER HECTARE	11,532	9,802	9,225
* PRICE PER UNIT (US$)	$ 7.17	$ 7.17	$ 7.17
= GROSS REVENUE PER HECTARE (US$)	$ 82,719	$ 70,311	$ 66,175
- OPERATING COSTS PER HECTARE (US$)**	$ 57,004	$ 49,990	$ 48,197
= NET REVENUE PER HECTARE (US$)	$ 25,712	$ 20,321	$ 17,978
FIVE LOSS MEASURES *			
1. LOSS PER HECTARE (US$)	$ -	$ 5,391	$ 7,733
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$ -	$ 22	$ 32
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	7%	9%
4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%)	0%	21%	30%
5. OPERATING PROFIT MARGIN (%)	40%	29%	27%

**Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

MICHIGAN - TABLE E.2: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

MICHIGAN	METHYL BROMIDE	1,3-D + PIC	METAM SODIUM	CHLOROPICRIN
PRODUCTION LOSS (%)	0%	6%	13%	6%
PRODUCTION PER HECTARE	4,414	4,132	3,845	4,132
* PRICE PER UNIT (US$)	$ 9.44	$ 9.44	$ 9.44	$ 9.448
= GROSS REVENUE PER HECTARE (US$)	$ 41,652	$ 38986	$ 36,279	$ 38986
- OPERATING COSTS PER HECTARE (US$)**	$ 37,055	$ 32453	$ 31,170	$ 32,453
= NET REVENUE PER HECTARE (US$)	$ 4596	$ 6,533	$ 5,109	$ 6,533
FIVE LOSS MEASURES *				
1. LOSS PER HECTARE (US$)	$ -	$ 1,937	$ 512	$ 1,937
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$ -	$ 16	$ 4	$ 16
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	5%	1%	5%
4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%)	0%	42%	11%	42%
5. OPERATING PROFIT MARGIN (%)	11%	17%	14%	17%

**Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

SOUTHEASTERN US - TABLE E.3: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

SOUTHEASTERN US	METHYL BROMIDE	1,3-D + PIC
PRODUCTION LOSS (%)	0%	6%
PRODUCTION PER HECTARE	4,551	4,269
* PRICE PER UNIT (US$)	$ 10	$ 10
= GROSS REVENUE PER HECTARE (US$)	$ 46,986	$ 44,073
- OPERATING COSTS PER HECTARE (US$)**	$ 26,660	$ 29,860
= NET REVENUE PER HECTARE (US$)	$ 20,326	14,212
FIVE LOSS MEASURES *		
1. LOSS PER HECTARE (US$)	$ -	$ 6,113
2. LOSS PER KILOGRAM OF METHYL BROMIDE (US$)	$ -	$ 36
3. LOSS AS A PERCENTAGE OF GROSS REVENUE (%)	0%	13%
4. LOSS AS A PERCENTAGE OF NET OPERATING REVENUE (%)	0%	30%
5. OPERATING PROFIT MARGIN (%)	43%	32%

**Note that the measures in the tables below must be interpreted carefully. Operating costs do not include fixed costs and net revenue equals gross revenue minus operating costs.

Summary of Economic Feasibility

The economic analysis of the tomato application compared data on yields, crop prices, revenues and costs using methyl bromide and using alternative pest control regimens in order to estimate the loss of methyl bromide availability. The alternatives identified as technically feasible - in cases of low pest infestation - by the U.S. are: (a) 1,3-Dichloropropene and Chloropicrin; (b) Metam sodium; and (c) Chloropicrin. Changes in pest control costs for tomatoes are less than 4 percent of total variable costs therefore they would have little impact on any of the economic measures used in the analysis.

The economic factors that really drives the feasibility analysis for fresh market tomato uses of methyl bromide are: (1) yield losses, referring to reductions in the quantity produced, (2) increased production costs, which may be due to the higher-cost of using an alternative, additional pest control requirements, and/or resulting shifts in other production or harvesting practices (3) quality losses, which generally affect the quantity and price received for the goods, and (4) missed market windows due to plant back time restrictions, which also affect the quantity and price received for the goods.

The economic reviewers then analyzed crop budgets for pre-plant sectors to determine the likely economic impact if methyl bromide were unavailable. Various measures were used to quantify the impacts, including the following:

(1) Loss per Hectare. For crops, this measure is closely tied to income. It is relatively easy to measure, but may be difficult to interpret in isolation.

(2) Loss per Kilogram of Methyl Bromide. This measure indicates the value of methyl bromide to crop production.

(3) Loss as a Percentage of Gross Revenue. This measure has the advantage that gross revenues are usually easy to measure, at least over some unit, e.g., a hectare of land or a storage operation. However, high value commodities or crops may provide high revenues but may also entail high costs. Losses of even a small percentage of gross revenues could have important impacts on the profitability of the activity.

(4) Loss as a Percentage of Net Operating Revenue. We define net cash revenues as gross revenues minus operating costs. This is a very good indicator as to the direct losses of income that may be suffered by the owners or operators of an enterprise. However, operating costs can often be difficult to measure and verify.

(5) Operating Profit Margin. We define operating profit margin to be net operating revenue divided by gross revenue per hectare. This measure would provide the best indication of the total impact of the loss of methyl bromide to an enterprise. Again, operating costs may be difficult to measure and fixed costs even more difficult, therefore fixed costs were not included in the analysis.

These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users, who are tomato producers in this case. Because producers (suppliers) represent an integral part of any definition of a market, we interpret the threshold of significant market disruption to be met if there is a significant impact on commodity suppliers using methyl bromide. The economic measures provide the basis for making that determination.

California

We conclude that, at present, no economically feasible alternatives to MeBr exist for use in California tomato production. We have quantified the economic conditions of tomato growers as best as possible but, primarily due to limited data availability, are unable to capture every aspect of the economic picture in our numeric analysis. Factors not accounted for in this analysis are distribution of yield loss across individual growers and the yield risk associated with using MeBr alternatives.

Michigan

We conclude that, at present, no economically feasible alternatives to MeBr exist for use in Michigan tomato production. Three factors have proven most important in our conclusion. These are yield loss, quality loss, and missed market windows.

Our analysis of this effect is based on the fact that prices farmers receive for their tomatoes vary widely over the course of the growing season. Driving these fluctuations are the forces of supply and demand. Early in the growing season, when relatively few tomatoes are harvested, the supply is at is lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, tomato growers manage their production systems with the goal of harvesting the largest possible quantity of tomatoes when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of tomato operations.

To describe these conditions in Michigan tomato production, we used daily tomato sales data from the U.S. Department of Agriculture for the previous year to gauge the impact of early season price fluctuations on gross revenues. Though data availability is limiting, we assume that if tomato growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin or Metam-Sodium or Chloropicrin, that they will, over the course of the growing season, accumulate gross revenues reduced by approximately 4~11%. We reduced the season average price by 4~11% in our analysis of the alternatives to reflect this. Based on currently available information, we believe this reduction in gross revenues serves as a reasonable indicator of the typical effect of planting delays resulting when MeBr alternatives are used in Michigan.

Southeastern US

We conclude that, at present, no economically feasible alternatives to MeBr exist for use in Southeastern US tomato production. Two factors have proven most important in our conclusion. These are yield loss and missed market windows.

Our analysis of this effect is based on the fact that prices farmers receive for their tomatoes vary widely over the course of the growing season. Driving these fluctuations are the forces of supply and demand. Early in the growing season, when relatively few tomatoes are harvested, the supply is at is lowest and the market price is at its highest. As harvested quantities increase, the price declines. In order to maximize their revenues, tomato growers manage their production systems with the goal of harvesting the largest possible quantity of tomatoes when the prices are at their highs. The ability to sell produce at these higher prices makes a significant contribution toward the profitability of tomato operations.

To describe these conditions in Southeastern US tomato production, we used weekly tomato sales data from the U.S. Department of Agriculture for the previous three years to gauge the impact of early season price fluctuations on gross revenues. Though data availability is limiting, we assume that if tomato growers adjust the timing of their production system, as required when using 1,3-D + Chloropicrin, that they will, over the course of the growing season, accumulate gross revenues reduced by approximately 12%. We reduced the season average price by 12% in our analysis of the alternatives to reflect this. Based on currently available information, we believe this reduction in gross revenues serves as a reasonable indicator of the typical effect of planting delays resulting when MeBr alternatives are used in Southeastern US.

Question 34. In Michigan, the key pests are Phytophthora capsici and Verticillium. The Party states that 1,3-Dichloropicrin may be an effective alternative but growers will miss the optimal market window. The Party is requested to clarify why this problem cannot be overcome by scheduling fumigations in autumn prior to the crop.

ANSWER:
The proposal by MBTOC to obviate the use of methyl bromide in Michigan by applying some alternative (specifically a combination of 1,3-D and chloropicrin) in the autumn preceding crop planting will not work on tomatoes. In Michigan, the predominant agricultural treatment that uses methyl bromide is one where methyl bromide is applied in strips of raised beds. Areas between the raised beds are not treated. In addition to the risk that the harsh winter conditions (prolonged periods of below freezing weather with snow, sleet, and high winds) will tear the plastic barrier,

there is significant risk of flooding and concomitant recontamination of the treated areas. The length and severity of the winter means 4-5 months of precipitation is 'stored' in frozen form and released over the short period of thaw in the spring. This thaw-based flooding can be exacerbated by heavy rainfalls (in excess of 25 mm/event) that occur throughout the spring and summer in Michigan. Because Phytophthora and Verticillium diseases are endemic in the areas of Michigan for which methyl bromide is being requested, flooding will transfer spores from the untreated to treated areas, resulting in additional infected plants and severe crop losses.

There are two additional problems which prevent a fall application of a methyl bromide alternative from being a viable alternative to the current practice. Deer walk across the fields, making holes in the plastic. Mice also burrow under the plastic. Once underneath they chew the drip tapes, rendering them inoperative and make burrows where they are in an ideal position to eat the newly planted material in the spring.

Question 35. In the Southeast, including Florida, nematodes, soil borne fungi and nutsedge are the key pests. The Party states that a combination of 1,3D + chloropicrin + herbicides (trifluralin, napropamide, halosulfuron, S-metolachlor)is the best alternative strategy, but further testing is required. However, the Party estimates yield losses of 6.2% and market window losses of 14% due to delays in plant back after treatment. This combination is not available to areas with karst topography (32 % of the production). The Party is requested to provide yield and market window data for other alternatives.

ANSWER:
Please see the answer to question 33 above

Question 36. Owing to the lack of data from recent trials in the south east region provided with the nomination, MBTOC cannot fully evaluate the effectiveness of alternatives for moderate to heavy nutgrass infestations. New technical review and economic data based on the yields from recent studies is requested.

ANSWER:
In Florida Gilreath et al 2003 looked at methyl bromide plus chloropicrin (350 lb per acre of 67:33) versus 1,3-D-35%Pic/trifluralin/napropamide/chloropicrin (28 gal/0.5 lb/2 lb/125 lb) for pepper yield. While the yields were not significantly different there was a 14 to 13 percent yield loss compared to methyl bromide plus chloropicrin. In addition this alternative treatment with additional chemicals will require extra time to apply the other pesticides and allow the second application of chloropicrin to off gas so that the transplants are not killed. This additional time delay would lead to impacts in terms of the key market windows.

Table 22. Tomato yields are not significantly different but percent yield loss can be large

Treatment	Bradenton		Immokalee	
	Marketable Yield (pound per 10 plants)	**% Yield Change versus MeBr**	**Marketable Yield (pound per 10 plants)**	**% Yield Change versus MeBr**

Untreated	51	-56%	108	-16%
Methyl bromide:chloropicrin (350 lb of 67:33)	117	0%	128	0%
1,3-D-35%Pic + trifluralin + napropamide + chloropicrin (28 gal/0.5 lb/2 lb/125 lb)	101	-14%	112	-13%

Footnote: From Gilreath et al. 2003. Proc. Fla. State Hort. Soc.

One of the studies that MBTOC cites is from Florida (Gilreath et al, 2005a), which looked at the impact of reduced rates of MB on pest control and pepper yield. In that study, which had high *Cyperus* spp. pressure, there were no significant differences in yield between any of the rates of methyl bromide with the different types of films. However, an examination of the change in yield with VIF treatments, compared to the standard MB treatments, suggests significant variability within treatments, which led to the lack of statistical significance in yield despite the large numerical differences in yield between treatments. Trials such as those conducted by Gilreath et al (2005 a) with peppers, need to be conducted over several seasons, and preferably with different crops. The reality of the use of VIF for the 2007 season is its current prohibitive cost in the U.S., and even more significant, its lack of availability for use on a commercial scale. The Party does not anticipate these issues can be adequately resolved before the critical use season of 2007.

Table 23. Pepper yields are not significantly different but percent yield loss can be large.

	Treatment	App Rate kg/ha	Yield t/ha	% Change
1	Untreated		9.5	-31%
2	MeBr + Pic LDPE	392	13.8	0%
3	MeBr + Pic VIFP	196	10.8	-22%
4	MeBr + Pic VIFP	98	13.6	1%
5	MeBr + Pic VIFV	196	11.4	-17%
6	MeBr + Pic VIFV	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287.
LDPE is low density polyethylene, VIFP and VIFV are virtually impermeable film by Plastopil and Vikase respectively.

The research plots that several MBTOC members visited in Florida in 2005 clearly demonstrated that chloropicrin will not control sedges such as *Cyperus esculentus* or *C. rotundus* . Research by Gilreath and communications with him indicate that chloropicrin enhances nutsedge germination (this research has yet to be repeated for other pest species). Therefore, increasing the amount of chloropicrin applied can increase pest pressure and yield loss.

Another study by Gilreath, Santos, Motis, Noling and Mirusso (2005) looks at nematode and *Cyperus* control in bell pepper (*Capsicum annum*). In that study the authors state "For bell pepper yield, the application of metam sodium and metam sodium + chloropicrin provided similar fruit weight as for methyl bromide + chloropicrin in two of the three seasons." However, in that one year (Fall 2002) the yields went from 18.8 t/ha for methyl bromide + chloropicrin to 13.7 t/ha for metam sodium + chloropicrin or a 27% drop in yield. This level of yield loss could have severe economic impacts for a grower. Because of the inconsistency of some of the alternative treatments the U.S. does not consider them to be a replacement for methyl bromide. The work of Johnson and Webster (2001) as described in Question 12 above indicated that for metam sodium the time of application before transplanting, rate, and type of incorporation equipment can all have a significant impact on the chemicals performance.

Question 37. Recent references available to MBTOC demonstrate effective alternatives (metham sodium, with and without Pic) for moderate to heavy nutgrass control in similar regions to the nomination and for non-karst and karst areas (Johnson and Webster, 2001 ;Gilreath et a12005 b,c). As yields were similar to methyl bromide, further clarification is required on their suitability for commercial use,

ANSWER:
The work of Johnson and Webster (2001) published in Weed Technology describes a modification to a power tiller for improved metham application. In this study across the control of yellow nutsedge was evaluated with the untreated control areas averaging 88 plants/m^2 and across all tillage treatments and cultivars, there was an average of 2.7 nutsedge plants/m^2 . See also the description of the Gilreath et al 2005 research in question 36 above.

Question 38. For all areas the dosage range is close to or below MBTOC guideline rates: Growers may be able to reduce dosages to about 100 kg/ha under strips by adoption of low permeability barrier films (VIF or equivalent) and by adopting formulations of MB/Pic with less MB (e.g. 50:50). Recent trials are evaluating use of these products and an update of these is requested to further assist assessment of this nomination.

ANSWER:
One of the studies that MBTOC cites is from Florida (Gilreath et al, 2005a), which looked at the impact of reduced rates of MB on pest control and pepper yield. In that study, which had high *Cyperus* spp. pressure, there were no significant differences in yield between any of the rates of methyl bromide with the different types of films. However, an examination of the change in yield with VIF treatments, compared to the standard MB treatments, suggests significant variability within treatments, which led to the lack of statistical significance in yield despite the large numerical differences in yield between treatments. Trials such as those conducted by Gilreath et al (2005a) with peppers, need to be conducted over several seasons, and preferably with different crops. The reality of the use of VIF for the 2007 season is its current prohibitive cost in the U.S., and even more significant, its lack of availability for use on a commercial scale. The Party does not anticipate these issues can be adequately resolved before the critical use season of 2007.

Table 24. Pepper yields are not significantly different but percent yield loss can be large.

	Treatment	App Rate kg/ha	Yield t/ha	% Change

1	Untreated		9.5	-31%
2	MeBr + Pic LDPE	392	13.8	0%
3	MeBr + Pic VIFP	196	10.8	-22%
4	MeBr + Pic VIFP	98	13.6	1%
5	MeBr + Pic VIFV	196	11.4	-17%
6	MeBr + Pic VIFV	98	11.9	-14%

Footnote: From Gilreath et al. 2005. Crop Protection 24: 285-287.
LDPE is low density polyethylene, VIFP and VIFV are virtually impermeable film by Plastopil and Vikase respectively.

The research plots that several MBTOC members visited in Florida in 2005 clearly demonstrated that chloropicrin will not control sedges such as *Cyperus esculentus* or *C. rotundus* . Research by Gilreath and communications with him indicate that chloropicrin enhances nutsedge germination (this research has yet to be repeated for other pest species). Therefore, increasing the amount of chloropicrin applied can increase pest pressure and yield loss.

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Appendix I Summary of Weyerhaeser Company Research

Summary of recent (2002-2005) Weyerhaeuser Company research studies concerning MB, fumigation efficacy, herbicides and alternatives to methyl bromide studies that pertain to the submitted questions.

Weyerhaeuser

<u>2002 Weyerhaeuser R&D Activities on Fumigation, Disease and Trials</u>

<u>2003-25</u> <u>Fumigation Alternative Trial (Mima, WA).</u> MBC 67:33 (350lbs/ac) was tested against Triform 35(400lbs/ac Telone 61.1% PIC 35% : no Metam Sodium applied due to lack of application equipment) in the fall 2000. Post fumigation testing (**Study 2001-25**) spring 2001 showed no significant difference in soil *Fusarium* populations. Soil testing in the fall of 2002, again showed very low levels of soil *Fusarium*. Root infection was analyzed several months into 1+1 transplant growing season (August 2002). Root infection by *Fusarium* was low and not significantly different between treatments (1.9% versus 2.5% MBC and Triform respectively). Root infection by *Cylindrocarpon* was significantly lower in Triform (1.5%) than in MBC (25.1%) treated plots.

<u>Interpretations:</u> Soil pathogen assays are used to estimate the need for and assess the efficacy of soil fumigation chemicals. Based on this and previous tests, these two fumigants appear to be equal in efficacy. Clearly, this study indicates that reliance on a single bioassay organism (*Fusarium*) can lead to this conclusion, while tests for another root-pathogen yield somewhat different results. Reliance on a single fumigant agent could potentially result in development of resistant strains or selection for another pathogen agent.

<u>2003-25</u> <u>Fumigation Alternative Trial (GHW, NC).</u> MBC 98:2, Telone-PIC, and PIC fall 2001 fumigation efficacy was tested on previous soils left bare fallow for 6-months. Soils and seedlings were analyzed for pathogen levels in the fall of 2002. There was no significant difference in soil *Fusarium* levels detected at lift (128, 156, and 98 CFU/g respectively). Seedling root infection severity was also low (6%, 6.8%, 8.6% respectively) and not significantly different between treatments. No Pythium was detected in soil or seedling assays.

<u>Interpretations:</u> Under these ideal fall fumigation conditions, low pre-fumigation pathogen populations, low weed pressure, and methods of application, MBC, Telone-PIC and PIC are acceptable alternatives as soil fumigants.

<u>2002-5,6,7,8</u> Pre<u>-Sow Pathogen Testing (N.C., AR., S.C., AL).</u> Soil pathogen testing shows variable spring 2002 *Fusarium* populations prior to sowing at four facilities. Samples were compared against the fumigation management threshold of < 1000 CFU/g soil). Pine Hill nursery shows 5/18 samples within the threshold (top range 508-1142 CFU/g soil). GHW samples (n=6) all tested below the threshold (all samples < 417 CFU/g soil). Aiken had 3/13 areas test within the threshold (range 700-1500 CFU/g soil). Magnolia reported with 8/10 within the threshold (range 595-3825 CFU/g soil).

<u>Interpretations:</u> Sow ground should be managed below 1000 CFU/g Fusarium in the spring to achieve a healthy pine crop. Soil testing of potential crop areas can help to identify areas that should be further tested for pathogen uniformity or left fallow. Disease avoidance is another mechanism of preventative action when sow acreage is not limited, too little time remains for safe and effective fumigation, or areas of unexpected disease develop

<u>2002-15</u> Post-Fumigation <u>Testing (S.C).</u> Soil pathogen testing in the spring following fall application of MBC 98:2 shows detectable Fusarium levels in 8/12 sample locations (range CFU/g 27-365).

<u>Interpretations:</u> Re-invasion of fumigated soil can occur from above and below the fumigation treatment profile. Good soil sanitation processes are needed to limit cross-contamination of treated and non-treated fields by equipment, overland water and soil movement, and incorporation of non-treated edge soils into treated areas.

<u>2002-20</u> <u>Alternative Fumigant Testing (AR).</u> Continuation of Studies (2000-47, 54, Study 2002-31) Soil pathogen testing following fall 2000 application of MBC (98:2), PIC (100%) and Telone-PIC (70:30) showed no significant difference in post treatment efficacy in areas that contained low-threshold levels of soil *Fusarium* (pre-treatment levels; MBC 272-1170 CFU/g; PIC 0-798 CFU/g; and Telone-PIC 0-506 CFU/g soil respectively). At pre-sow 2001, Fusarium was detected in 3/10, 1/10, and 1/10 sample locations for MBC, PIC, and Telone-PIC respectively (levels 44-431 CFU/g soil). Sampling resumed spring 2002 following the 2001 pine crop cycle. Soil *Fusarium* levels were similar in all three treatment areas (MBC 243 CFU/g, PIC 140 CFU/g, and Telone-PIC 261 CFU/g soil). Seedling root infection by *Fusarium* was not significantly different between treatments, but a trend towards higher root infection occurred between MBC (19% root infection), PIC (17%) and Telone-PIC (10%).

<u>Interpretations:</u> MBC, PIC and Telone-PIC produce equivalent fumigation results across management blocks with low-threshold levels of Fusarium as the target organism. The longer-term crop to crop rotation length based on soil *Fusarium* population dynamics appears similar when these agents are used in the prescribed manner.

<u>2002-49</u> <u>Fumigation Efficacy (GHW, NC).</u> Routine sampling post-fumigation soil pathogen analysis was done to test the efficacy of contractor applied MBC 98:2. Some 40% of the samples returned detectable levels of *Fusarium* (43-362 CFU/g) one month post fumigation. These soils were retested again in March 2003 as part of **Study 2003-1**. These results also confirmed some residual *Fusarium* populations post-fumigation.

<u>Interpretations:</u> Complete control of soil pathogen populations is essential to initiation of the next 3-4 seedling crop cycles. The detected pathogen pattern might reflect under treated areas, overlaps zones of tarping, fumigation strips, edge effects, and or soil and water movement post fumigation (wind, water, mechanical). These issues will be more critical with less effective fumigants and potentially result in larger "under treated" areas.

<u>2002-50</u> <u>Fumigation Efficacy (S.C.).</u> Routine sampling post-fumigation soil pathogen analysis was done to test the efficacy of contractor applied MBC 98:2 in two management units. Pivot 1-5 showed ½ of the area with a post-treatment efficacy of 65-80% and 100% in the remaining areas. Pivot 1-6 showed 53-84% efficacy on ½ of the area with the remaining sample at 100%.

<u>Interpretations:</u> Incomplete efficacy of MBC is often linked to failure to achieve label rates due to penetration or retention issues. The cause was not investigated at the time of the fumigation, but appears to be a common practice with the fumigation being done in any given year.

<u>2002-51</u> <u>Pathogen Testing (Pine Hill AL).</u> Routine pre-fumigation soil pathogen analysis was done to test crop areas in three production blocks. Block 1 (909 CFU/g soil) and Block 2 (668 CFU/g) showed much elevated *Fusarium* levels than Block 4 at 173 CFU/g.

<u>Interpretations:</u> Variation in soil Fusarium populations increase following the period since last fumigation. Historical data along with new specific sampling information from specific nursery blocks are the best management tool to decide on when and where to fumigate.

<u>2003-25</u> <u>Fumigation Versus Bare-Fallow (Mima, WA).</u> Block 8 was spring fumigated with 350lb/ac MBC (67:33) following 1-year in bare-fallow (Roundup Treated Spring 2002). The field had been previously cropped for 1-year following MBC fumigation, then allowed to remain fallow through the next crop year and brought back into crop rotation in the spring of 2002. Roundup (Glyphosate) was applied 30 days prior to fumigation to kill surface weeds. Soil and root residual pathogen analysis (*Fusarium, Pythium, Cylindrocarpon*) was conducted prior to fumigation planning. These results showed no detectable pathogen population on 2/3rd of the field, but some elevated levels on a normally wet end, some 150 feet in length. MBC 67:33 was applied to the wet area and tarped. Douglas-fir 1-year old seedlings were transplanted in spring 2002 to grow 1+1 regeneration stock.

Severe stem and needle stunt symptoms began to develop in late-June and into July in the non-fumigated portions of the field. Soil and foliar analysis did not detect any nutrient based causal factors. Root necrosis associated with elevated levels of *Cylindrocarpon didymum* and *Fusarium oxysporum* on transplants were determined to be the most likely pathogen agents. All attempts to correct seedling growth and development with fertilizers, fungicides, and irrigation failed. Substantial portions of the field seedlings did not meet regeneration standards, and had to be destroyed. The fumigation portion was nearly 90+% packable.

Interpretations: 1-year bare fallow was insufficient to reduce disease levels below thresholds for disease development. Glyphosate, although an effective herbicide on surface weeds may also play a synergistic role in plant disease development, by interfering with normal plant phenolic metabolism. Soil and root residual pathogen testing is not always a reliable measure of soil disease potential.

2003 Weyerhaeuser R&D Activities on Fumigation, Disease and Trials

2003-2 Fumigation Threshold Testing (AR). Areas of Blocks 7, 8, and 10 were sampled for Fusarium levels to indicate the need for fumigation. Two units within Block 10 contained sufficient *Fusarium* (800-1400 CFU/g soil) to justify soil fumigation.

Interpretations: Soil pathogen assays are used to estimate the need for and assess the efficacy of soil fumigation chemicals. Based on this sample, much of the crop area would not benefit from soil fumigation at this time.

2003-12 Fumigation Threshold Testing (S.C.). Soil sampling across portions of Pivot 3 show variable levels of soil Fusarium. Three of 18 areas tested greater than 400 CFU/g soil, where the decision to fumigation can sometimes begin.

Interpretations:
The soil sampling method and testing allows for the planning for most effective use of MBC in the nursery. This pivot area needs to be resampled to determine the validity of high soil Fusarium levels detected in portions of a production field, while other areas appear to be safe for cropping.

2003-18 Fumigation Threshold Testing (AL). Soil sampling across portions of Blocks 10 and 19 show low levels of soil Fusarium (0-220 CFU/g soil). These soils are well within the safe zone for pine seedbed production.

Interpretations:
The soil sampling method and testing allows for the effective soil management decision making.

2003-25 Pathogen Contributions Packing Room (Turner, OR). Soil sampling across fumigated and non-fumigated portions of Block1, 2 and 3 show low levels of soil Fusarium (0-223 CFU/g soil). Variation was minimal within blocks and even in immediately adjacent non-fumigated areas. These soils are well within the safe zone for Douglas-fir transplant production. Soil and the roots from the packing room was collected and tested for *Fusarium*, *Pythium*, and *Cylindrocarpon*. Direct isolation from sample root fragments was compared with levels of each fungus “baited” using sterile autoclaved Douglas-fir roots.

Roughly 10% of the root residues from fumigated and non-fumigated areas yielded *Pythium*, although fewer roots could be recovered from the non-fumigated areas (previous crop residuals). Pack room root residuals yielded *Pythium* from 17% of the isolation attempts. Attempts to bait it from soil was only successful in one fumigated sample, but several non-fumigated samples and more so from the soil in the packing room.

Fusarium was isolated from about 3% of the root residuals and did not show any pattern to fumigation or packing room samples. Baiting reduced the isolation frequency to about 1.5%.

Cylindrocarpon represented some 4% of the root fragment isolates and there was no pattern to root residual source. Attempts to bait this fungus yielded low results.

Interpretations:

Seedling harvest activities yields many pounds of soil and root fragments as a consequence of lifting and storing regeneration stock. It is common practice to return these residues to fields that will be fallow or fumigated during the next crop cycle, but some facilities will compost the residues prior to land application. These residue potentially harbor considerable reservoirs of pathogens, especially if the field is further into the fumigation rotation. In this example, even though the fields show low levels of all three pathogens they might still be expected to increase once applied to soils. Proper sanitation procedures dictate not returning these soils or roots to production fields.

2003-34 Alternative Fumigation Testing (AR). Soil sampling in June following fall fumigation at Magnolia with MBC (98:2), Telone-PIC and PIC show no significant differences in soil *Fusarium* levels (158 CFU/g, 91 CFU/g, and 82 CFU/g respectively).

Interpretations:

The replication of tests between facilities is needed to fully understand the potential for alternative agents to serve as replacements for MB. This test confirms previous data on the efficacy of Telone-PIC and PIC as soil fumigants under normative prescriptions for soil fumigation.

2004 Weyerhaeuser R&D Activities on Fumigation, Disease and Trials

2004-15 Fumigation Skip Investigation (Mima, WA). Soil sampling in spring in Blk-14 was initiated after a circular weedy patch (roughly 100 sq ft) developed in a field treated with MBC 67:33 the previous fall. Sampling and around the weedy area turned up no significant pathogen (Fusarium, Cylindrocarpon) population.

Interpretations: The sampling satisfies concerns over a fumigation skip. Weed invasion is more likely associated with equipment or soil movement.

2004-16 Nursery Pathogen Management (AL). Soil sampling in spring across 18 Pine Hill nursery growing blocks shows the within facility variation in pathogen occurrence by field management and past fumigation history. In eight fields (44%) pathogen levels were categorized as low to not-detectable (< 100 CFU/g soil). Seven fields (39%) tested within the low to moderate range (100-400 CFU/g soil). Three fields were within the target threshold for cropping (600-1205 CFU/g soil), and would most likely be in need of fumigation after the next crop cycle.

Interpretations: Block management is an important factor in achieving consistent crop production. Fall fumigation has been proven to be more effective than spring fumigation owing to optimal chemical, climatic and cultural aspects. It is prudent for a facility to maintain a large percentage of its production ground in a state of "disease-free" growing, represented here by pathogen population estimates. This allows for better identification, timing and optimal fumigation on the nursery areas outside the normative prescription for pathogens.

2004-38; 2004-62, 2004-64 Alternative Fumigation Testing (Aurora, OR). Soil sampling in June following fall fumigation at MBC (67:33), Telone-PIC and PIC show no significant differences in soil *Fusarium* levels in Douglas-fir seedbeds (0 CFU/g, 93 CFU/g, and 34 CFU/g respectively). Samples were taken in December of 2004 (**Study 2004-62**) to determine *Fusarium* levels at the end the growing season. These results show that after 1-year in crop the soil levels had raised to 315 CFU/g soil (MBC), 167 CRU/g (Telone-PIC); and 176 CFU/g (PIC). Seedling infection levels (Study 2004-64) pathogen and non-pathogen fungal groups were determined. Differences between fumigation treatments were not significant. Isolation of *Fusarium oxysporum* from roots declined from 4.6% (PIC), 5.1% (Telone-PIC) to 9.7% with MBC 67:33. Isolation frequency of *Fusarium roseum* (1.6-2.3%), *Phoma sp*. (19-22.6%), and *Cylindrocarpon* (0-0.3%) varied little by treatment.

Interpretations: Fumigation with MBC, Telone-PIC or PIC demonstrates similar pathogen control in soils of widely varying texture and composition. Under these culture conditions the build-up post treatment and infections levels that result appear similar for all three fumigants.

<u>2004-63 Alternative Fumigation Testing (Mima, WA).</u>   Soil sampling in December from soils treated with MBC (67:33), PIC (350lbs/ac) or Metam Sodium (100 gal/ac) showed varied results to pathogen abundance. *Fusarium* was not detected in plots taken in MBC fumigated ground, while C350 contained background levels (55 CFU/g soil) and slightly higher for Metam (181 CFU/g soil). *Phoma* was far more common as a soil isolate in Metam treated soil (2173 CFU/g) than C350 (1403 CFU/g) or MBC (667 CFU/g). *Cylindrocarpon* was only detected in 3 plots all treated with MBC (18 CFU/g soil).

<u>Interpretations:</u> Most testing for fumigation efficacy has been done with a specific "target" pathogen, in most examples, *Fusarium oxysporum*. This study provides some evidence that this technique may be a technology shortcoming, and that not all pathogenic fungi are controlled in the same manner. This also provides some clues as to the appearance and dominance of *Cylindrocarpon* in some nursery production blocks, where it seemingly had not existed before. These results might further support the need for rotation of fumigants, rates, or fumigant mixtures, not merely selection of the "next" best fumigant. Further testing is needed to understand the shortcomings of a particular fumigant and the conditions which facilitate pathogen escape.

<u>2004-71 Alternative Fumigation Test (Mima, WA).</u>   Soil sampling was conducted in Blk 12 during the late fall after being treated with MBC (67:33) or with increasing levels of PIC (150lbs/ac, 250 lbs/ac, and 350 labs/ac). Post-treatment soil *Fusarium* was very low (11-43 CFU/g) and not significantly different between treatment plots. In contrast, *Phoma* was very high (1790-4675 CFU/g) and not consistent with increasing fumigation rates. Cylindrocarpon was low (0-27 CFU/g soil) in all treatments.

<u>Interpretations:</u> The information provided in this analysis shows that pathogen response to various fumigants, and rates of application may be more variable than previously thought. Control for one target organism may fit the expectation of the sanitation process, while another organism is not controlled to any degree. The long-term interactions of differential pathogen control remains to be examined and understood.

Appendix II Economic information for Michigan Herbaceous Perennials

REGION H - MICHIGAN HERBACEOUS PERENNIALS - TABLE E.8: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

Region H - Michigan Herbaceous Perennials	Methyl Bromide	Various Alternatives**
Yield Loss (%)	0%	5%
Yield per Hectare Conifer Seedlings	144,920	137,674
* Price per Unit (U.S. $/seedling)	$ 0.97	$ 0.97
= Gross Revenue per Proportion (60%)	$ 140,956	$ 133,908
- Operating Cost per Hectare (U.S. $)	$ 37,311	$ 58,414
= Net Revenue per Hectare (U.S. $)	$ 103,645	$ 75,494
Loss Measures		
1. Loss per Hectare (U.S. $)	$0	$ 28,151
2. Loss per Kilogram of Methyl Bromide (U.S. $)	$0	$ 143.52
3. Loss as a Percentage of Gross Revenue (%)	0%	21%
4. Loss as a Percentage of Net Revenue (%)	0%	37%

** The category Various Alternatives includes physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

Worksheet 3-B2 (3). Alternatives - Changes in Operating Costs for Perennial Crops

Alternative: **Grown In Artificial Media on Acreage Prepared as Container Field (Soiless culture/plugs substrates)**

A	B (1)	C (1)	D (1)	E (1)	B (2)	C (2)	D (2)	E (2)
	PRE PRODUCTION YEAR 1				**Harvest Year 2**			
Operation or Input	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**
Establishment Operations								
Land preparation				768.00				
Fumigation								
product								
application								
Irrigation								
Bulb crates and media	11,293	crates	$ 2.50	28,233.00				
Seedlings	67,760	plants	$ 0.80	67,760.00				
Cultural Operations								
Fertilizer/soil amendments	450	lbs	$ 1.00	498.00	450	lbs	$ 1.00	498.00
Pesticides								
Insecticide								
Herbicide								
Fungicide								
Nematicide								
Irrigation	32	man hours	$ 15.00	480.00	32	man hours	$ 15.00	480.00
Interest on Land Prep Charges	11,525		7.00%	807.00	11,525		7.00%	807.00
Interest on Operating Capital	98,950		6.00%	1,989.00	16,278		6.00%	488.00
Hand Weeding	96	man hours	$ 12.00	1,152.00	96	man hours	$ 12.00	1,152.00
Dept of Ag Inspection				20.00				20
Harvest Operations	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**
Labor and Hauling								1,440.00
Storage Cost								3,750.00
Processing						0.03	271040	8,131.00

EPA Form # 7620-18a $ 101,707.00 $ 16,766.00 $ 118,474.00 Year 1 & 2 Total Cost Per Acre

Economists Comments for worksheet 3-B2(3) – Artificial media on Acreage Prepared as Container Field Soiless culture/plugs substrates)

Year 1

- Land preparation: Container field preparation - $ 10,000 for leveling, draining, gravel roads, etc. and $ 0.05 per square foot (70% of acreage) for ground mat depreciated over 15 years.
- Bulb crates and media: $ 1 per crate and $ 1.50 for soil in crate – a crate is 2.7 sq ft and they cover 70% of the sq ft in an acre.
- Field clean up: Labor to pick up plastic, plastic disposal fee and tractor & trailer use (custom rate).
- Seedlings: Plants and planting costs. Takes 5 seconds per plant to put into bulb crates.
- Fertilizer/soil amendments: Includes material and application cost (1 hr/ac @ $ 12 4x).
- Irrigation: Labor to water about 2 " per week June 1- Sept 30.
- Interest on Operating Capital: Assume grower borrows half of variable expenses for 8 months in Year 1 and 12 months in Year 2.

Year 2

- Labor and Handling: Includes loading crates, hauling on trailer to polyhouse and unloading (120 person hrs/ac).

Worksheet 2-D(2a). Methyl Bromide - Baseline - Operating Costs for Perennial Crops - 2 Year Seeded

A	B (1)	C (1)	D (1)	E (1)	B (2)	C (2)	D (2)	E (2)				
	PRE PRODUCTION YEARS _______				**INITIAL PRODUCTION YEARS _____**							
Operation or Input	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**				
Establishment Operations												
Land preparation				170.00								
Fumigation												
product	$ 312.50	lbs MB/ch	$ 3.35	1,047.00								
application				809.00								
Irrigation												
Seed and Seeding								287.00				
Other costs				63.00				63.00				
Cultural Operations												
Fertilizer/soil amendments				73.00				60.00				
Pesticides												
Insecticide												
Herbicide				12.00								
Fungicide								356.00				
Custom application of fungicide					$ 12.00	application	$ 15.00	180.00				
Irrigation								70.00				
Hand hoeing & Trimming					$ 120	hrs	$ 12.00	1440.00				
Fuel/machine labor								115.00				
Interst on Operting Capital	$ 2,194		6.00%	33.00	$ 7,409		6.00%	167.00				
Dept of Ag Inspection				20.00				20.00				
Harvest Operations	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**				
Digging & Transporting								1007				
Grading/packing								1495				
Cold Storage								997				
Shipping								1329				
				2,227.00				7,586.00	9,813.00	Year 1 & 2 Total Cost/Ac		

EPA Form # 7620-18a

Pre Plant

Worksheet 2-D(2b). Methyl Bromide - Baseline - Operating Costs for Perennial Crops - 3 Year Transplanted

A	B (1)	C (1)	D (1)	E (1)	B (2)	C (2)	D (2)	E (2)				
	PRE PRODUCTION YEARS _______				INITIAL PRODUCTION YEARS _____							
Operation or Input	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**				
Establishment Operations												
Land preparation				112.00								
Fumigation												
product	$ 350.00	lbs MB/ch	$ 3.35	1,173.00								
application				632.00								
Cover Crops				100.00								
Seedlings	38,000	divisions	$ 0.03	1,241.00								
Other costs				1,624.00								
				7.00								
Cultural Operations												
Fertilizer/soil amendments				42.00				150.00				
Pesticides												
Insecticide & Fungicide				150.00				600.00				
Custom application of fungicide	3	applic	$ 15.00	45.00	$ 15.00	application	$ 15.00	225.00				
Hand weeding	10	hrs	$ 12.00	120.00	$ 40.00	hrs	$ 12.00	480.00				
Irrigation Labor & Operations	1.5	hrs	$ 15.00	23.00	3.5	hrs	$ 15.00	53.00				
Labor (manual)												
Mechanical Cultivation					10	hrs	$ 15.00	173.00				
Interest on Operting Capital	$ 5,288		6.00%	159.00	$ 7,409		6.00%	405.00				
Dept of Ag Inspection				20.00				20.00				
Harvest Operations	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**				
Cutting (Mechanical Operations)					2.7	hr/ac	$ 15.00	41				
Cutting & Packing (Labor)					522	hrs	12	6,261.00				
Equipment Rental												
Hi-Los								435				
Truck								495				
Trailers								275				
Packing Materials					20,000.00	flats	0.21	4305				
				5,447.00				13,917.00	19,364.00	Year 1 & 2 Total Cost/Ac		

EPA Form # 7620-18a

Pre Plant

Worksheet 2-D(2c). Methyl Bromide - Baseline - Operating Costs for Perennial Crops - 2 Year Transplanted

A	B (1)	C (1)	D (1)	E (1)	B (2)	C (2)	D (2)	E (2)				
	PRE PRODUCTION YEAR 1				Harvest Year 2							
Operation or Input	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**	**Quantity used per acre**	**Units (lbs, hours, etc)**	**Unit Cost**	**Total Cost per Acre**				
Establishment Operations												
Land preparation				167.00								
Fumigation												
product	400	lbs MB/ch	$ 3.35	1,340.00								
application				409.00								
Field clean up				135.00								
Irrigation												
Seedlings	50000	plants	$ 0.08	40,833.00								
Cultural Operations												
Fertilizer/soil amendments	450	lbs	$ 0.50	243.00	450	lbs	$ 0.50	243.00				
Pesticides												
Insecticide												
Herbicide												
Fungicide												
Custom application of fungicide												
Irrigation	16	man hrs	$ 15.00	240.00								
Hand hoeing & Trimming	192	man hrs	$ 12.00	2,304.00	$ 192	man hrs	$ 12.00	2304.00				
Fuel/machine labor												
Interest on Operating Capital	$ 45,691		6.00%	918.00	$ 11,740		6.00%	352.00				
Dept of Ag Inspection				20.00				20.00				
Harvest Operations	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**	**Constant Cost per Acre**	**Cost per Unit of Yield**	**Yield**	**Total Cost**				
Digging Labor								600				
Digging Equipment								633				
Storage Cost								1700				
Processing								6000				
				46,609.00				12,092.00	58,701.00	Year 1 & 2 Total Cost/Ac		

Economist’s comments for worksheet 2-D (2a) - 2 Year Seeded

Year 1

- Land preparation: Includes soil test, disk, plow, drag, float, apply fert., drag, apply herbicide, disk, drag, float – priced as custom rates so includes some fixed costs.
- Application: Includes custom application, tarp removal, and tarp disposal.
- Other costs: Post planting field prep. And cover crop – cover crop is certified seed to minimize weed contamination
- Fertilizer/soil amendments: Lime and potassium.
- Irrigation: Labor Solid set and hand hose – includes some fixed expense.
- Hand hoeing & Trimming: Includes hoeing (1x per month @ ½ ac per hour with 15 people) and trimming.
- Fuel/machine labor: Field maintenance – cultivation and driveway and ditch maintenance – includes some fixed cost.
- Interest on Operating Capital: Assume grower borrows half of variable expenses for 6 months in Year 1 and 9 months in Year 2.
- Cold Storage: $ 0.90 per sq ft – 90 d on #1 and 50 d on Liners

Year 2

- Fertilizer/soil amendments: 28% Nitrogen.

Economist’s comments for worksheet 2-D (2b) 3 Year Transplant

Year 1

- Land preparation: Includes soil test, disk, subsoil, plant & disc cover crop, disc, plow, drag.
- Application: Includes custom application cost (less materials) and plastic disposal and clean up.
- Cover crop: Cover crop seed is certified to minimize weed contamination.
- Planting labor: Includes splitting plants into divisions, transplanting into field and transport to field.
- Equipment Operation (Planting): Fuel and Maintenance on transplanter.
- Irrigation Labor and Operation: Includes labor (calculated) plus $ 0.10 per application in electricity & maintenance cost.
- Interest on Operating Capital: Assume grower borrows half of variable expenses for 12 months in Year 1 and 12 months in Year 2.

Year 2

- Cutting & Packaging Labor: 150 people per crew for an 8 hour day doing 2.3 ac per day
- Equipment rental: 10 hi-los, truck rental (4 trucks) plus truck mileage to and from field, Trailer rental (3 trailers) plus mileage to and from field

Economist’s comments for worksheet 2-D (2c) - 2 Year Transplanted

Year 1

- Land preparation: Includes chisel plow 3X and rotofill once before and once after fertilization.
- Application: Includes 2 people on hand at application to bury ends of plastic and assist custom operators.
- Field Clean Up: Labor to pick up plastic, plastic disposal fee and tractor & trailer use (custom rate)
- Seedling: Plants and planting costs.
- Fertilizer/soil amendments: Includes material and application cost.
- Irrigation: Labor to water about 1” per week June1 – Sept 30.
- Interest on Operating Capital: Assume grower borrows half of variable expenses for 8 months in Year 1 and 12 months in Year 2.

Year 2

- Digging Equipment: Includes custom rates for 2 tractors – 1 for digger and 1 for trailer – potato digger and trailer.
- Storage Cost: Includes mulch to cover in polyhouse and polyhouse rental ($0.50 per sq ft * 3,000 sq ft necessary for 1 acre hosta yield
- Processing: Splitting divisions.

Appendix III Revised BUNI for Fruit, Nut and Flower Nurseries

Methyl Bromide Critical Use Exemption Process — **Date:** 8/10/2005 — **Average Hectares in the US:** not available

2007 Methyl Bromide Usage Numerical Index (BUNI) — **Sector:** FRUIT, NUT, & FLOWER NURSERY — **% of Average Hectares Requested:**

	2007 Amount of Request			2001 & 2002 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		Research Amount (kgs)
REGION	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2001 & 2002 Average	Requested %	
Western Raspberry Nursery Consortium	53,416	212	252	27,379	117	235	60%	Not Available		1,506
CA Rose Growers ***	209,975	81	2,594	208,217	616	338	99%			
CA Assoc. - Fruit & Nut Tree Growers***	224,528	134	1,681	201,678	642	314	92%			
TOTAL OR AVERAGE	487,919	426	1,145	437,274	1,374	318				

2007 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE		
REGION	2007 Request	(-) Double Counting	(-) Growth	(-) Use Rate Adjustment	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)
Western Raspberry Nursery Consortium	53,416	-	26,037	-	16,427	10,952	10,952	10,952	47	235
CA Rose Growers	209,975	-	-	-	207,875	2,100	2,100	2,100	7	280
CA Assoc. - Fruit & Nut Tree Growers	224,528	-	-	-	206,566	17,962	17,962	17,962	57	314
Nomination Amount	487,919	487,919	461,882	461,882	31,014	31,014	31,014	31,014	111	279
% Reduction from Initial Request	0%	0%	5%	5%	94%	94%	94%	94%	74%	76%

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst (Telone)		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Cold Soil Temp (%)		Combined Impacts (%)	
REGION	Low	EPA	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
Western Raspberry Nursery Consortium	235	235	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%
CA Rose Growers	280	280	0	0	0	0	100	100	44	31	0	0	0	0	100%	100%
CA Assoc. - Fruit & Nut Tree Growers	314	314	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%

Other Considerations	Dichotomous Variables (Y/N)					Other Issues			Economic Analysis					
REGION	Strip Bed Treatment	Currently Use Alternatives?	Research / Transition Plans	Tarps / Deep Injection Used	Pest-free Cert. Requirement	Change from Prior CUE Request (+/-)	Verified Historic MeBr Use / State	Frequency of Treatment	Loss per Hectare (US$/ha)	Loss per Kilogram of MeBr (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue	Quality/ Time/ Market Window/ Yield Loss (%)	Marginal Strategy
Western Raspberry Nursery Consortium	No	No	Yes	Tarp	Yes	+	Yes	2-3x/1yr	Not included as there is no technically feasible alternative.					
CA Rose Growers	No	Yes	Yes	Tarp	Yes	-	Yes	3-5x/1yr						
CA Assoc. - Fruit & Nut Tree Growers	No	No	Yes	Tarp	Yes	0	Yes	3-5x/1yr						

Conversion Units: 1 Pound = 0.453592 Kilograms 1 Acre = 0.404686 Hectare

Most Likely Impact Value: High 24% Low 77%

*USEPA has recently been informed that a larger proportion of methyl bromide use falls under QPS therefore EPA has reduced the request to adjust for this new information.

* CA Deciduous Fruit & Nut Tree Growers have a new QPS % of 92% instead of their previous 100%.

* Raspberry was recalculated using original QPS% of 60% instead of 90% based on communications with Dave Riggs.

*** Recalculation of QPS based on conversation with Jim Wells on 8/5/2005. QPS should be calculated as 99and 92% of their total methyl bromide usage.

Appendix III Revised BUNI for Strawberry nurseries

Methyl Bromide Critical Use Exemption Process

2007 Methyl Bromide Usage Numerical Index (BUNI)

Date:	8/10/2005	Average Hectares in the US:	Not Available
Sector:	STRAWBERRY NURSERY	% of Average Hectares Requested:	

2007 Amount of Request				2001 & 2002 Average Use*			Quarantine and Pre-Shipment	Regional Hectares**		Research Amount (kgs)
REGION	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)		2001 & 2002 Average	Requested %	
CALIFORNIA***	443,432	522	263	365,045	1,386	263	99%	Not Available		454
SOUTHEASTERN US	43,292	105	413	28,499	69	413	89%			
TOTAL OR AVERAGE	486,723	627	776	393,544	1,455	270	94%			

2007 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE		
REGION	2007 Request	(-) Double Counting	(-) Growth*	(-) Use Rate Adjustment	(-) QPS	HIGH	LOW	Kilograms (kgs)	Hectares (ha)	Use Rate (kg/ha)
CALIFORNIA	443,432	-	-	-	438,997	4,434	4,434	4,434	17	263
SOUTHEASTERN US	43,292	-	14,793	4,370	21,475	2,654	2,654	2,654	8	350
Nomination Amount	486,723	486,723	471,930	467,561	7,089	7,089	7,089	7,089	24	290
% Reduction from Initial Request	0%	0%	3%	4%	99%	99%	99%	99%	96%	63%

Adjustments to Requested Amounts	Use Rate (kg/ha)		(%) Karst (Telone)		(%) 100 ft Buffer Zones		(%) Key Pest Distribution		Regulatory Issues (%)		Unsuitable Terrain (%)		Cold Soil Temp (%)		Combined Impacts (%)	
REGION	Low	EPA	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	HIGH	LOW
CALIFORNIA	263	263	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%
SOUTHEASTERN US	413	350	0	0	0	0	100	100	0	0	0	0	0	0	100%	100%

Other Considerations	Dichotomous Variables (Y/N)					Other Issues			Economic Analysis					
REGION	Strip Bed Treatment	Currently Use Alternatives?	Research / Transition Plans	Tarps / Deep Injection Used	Pest-free Cert. Requirement	Change from Prior CUE Request (+/-)	Verified Historic MeBr Use / State	Frequency of Treatment	Loss per Hectare (US$/ha)	Loss per Kilogram of MeBr (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue	Quality/ Time/ Market Window/ Yield Loss (%)	Marginal Strategy
CALIFORNIA	No	Yes	Yes	Tarp	Yes	+	Yes	2~5 years	$ 4,606	$ 17	10%	46%	10%	1,3-D + Pic
SOUTHEASTERN US	No	Yes	Yes	Tarp	Yes	+	Yes	2~5 years	$ 5,469	$ 13	13%	46%	10%	1,3-D + Pic

* Growth calculated after subtracting QPS

Conversion Units: 1 Pound = 0.453592 Kilograms 1 Acre = 0.404686 Hectare

Most Likely Impact Value: High 24% Low 77%

*** Recalculation of QPS based on conversation with Jim Wells on 8/5/2005. QPS should be calculated as 99and 92% of their total methyl bromide usage.

NOMINATING PARTY:	**The United States of America**
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	**JUNE 2005 QUESTIONS ON CUNS FOR 2006 AND/OR 2007 FOR POST-HARVEST APPLICATIONS**
DATE	Version of August 18, 2005

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I. Ham

Question 1. MBTOC remains concerned about the lack of prior data on amount of MB used, about the amount of MB requested for 2007 and about the lack of sealing in ham houses which would result in higher use of MB overall. MBTOC understands the reasons for difficulty in obtaining MB use data for before 2005, but believes the USG may be able to obtain and provide this use data for 2005, in 2006 since any MB used in 2005 will be controlled by USG, MBTOC needs this information before it can recommend an amount of MB for 2007, though recognizing that it has not identified alternatives to MB for this particular use and conditions.

MBTOC's information gathering with MB distributors in the regions where this product is made in the US indicates that the likely maximum MB use is 35 -40,000 lbs/yr. We have obtained this number over two separate years of investigation and we therefore believe that the amount nominated may exceed the quantity needed for this use considerably. We are also asking if, considering that actual MB use in this sector we believe is likely to be a maximum of 40,000 lbs, and since the MOP Prague granted 67 tonnes, if there will not be sufficient MB already granted to this sector to meet its needs for a couple of years.

The CUN indicates, and informal communications with persons who know about Southern US ham house operations indicate, the structures are likely to be quite poorly sealed. We have asked all Parties with CUN applications that indicate poorly sealed structures what they plan to do to ensure the structures are of good gastightness before MB is used. MBTOC believes that the use of MB in very poorly sealed structures does not meet the requirements of Decision IX/6.

Although we acknowledge that there may be no alternatives for this use, we also note that there does not seem to be any research effort to find an alternative although it is required by Decision IX/6. MBTOC has seen other Parties continue to conduct research on the other, similar, very difficult applications such as cheese and fresh chestnuts and encourages USG to conduct investigations of the ham operations and/or research on alternatives. In this instance it also appears that there is scope for improvements in IPM, and specifically in decreasing the conditions that lead to infestation and need for treatment with MB.

ANSWER:
USG requested amounts of methyl bromide from this sector based upon several sources, including the manufacturer and application companies.

We are unable to address MBTOC's concerns regarding lack of sealing in ham houses. It is USG's understanding that this sector has been sealing their buildings to increase gas tightness and reduce emissions. Unfortunately, due to the communication problems and the unique nature of this sector there appears to be some disconnect between the air tightness during the drying and aging process and the sealing and gas tightness during the fumigation process. Sealing to provide a gas tight structure is a label requirement and in our discussions with fumigation companies in this sector they have described they comply with these label requirements. Several of the applicants have built new facilities that are highly gas tight and easier to sanitize. Additionally, we realize that this is a small sector with a diverse range of sizes and building materials.

This is a small sector that has had very little research. One reason is that there were no registered alternatives, except phosphine in a few of the states. It was due to efforts to use phosphine as a replacement for methyl bromide that it was discovered that phosphine did not control mites. Recently this sector has been working with USDA. Also, this commodity has recently received a tolerance for sulfuryl fluoride on July 15, 2005. This industry hopes to begin testing sulfuryl fluoride to determine how to incorporate it into their IPM strategies.

With respect to the comment on the 67 ton approval for 2005, the United States does not allow CUEs approved for 2005 to carry through to future years, so this amount is not available for use in 2007 and therefore does not resolve the issue. Our estimates of use were made from the best available expert opinion and at this time we do not have a basis to revise our estimate to a different nominated amount. We would be interested in obtaining the use estimates obtained by MBTOC to ascertain their accuracy and comprehensiveness. The United States supports proper emission minimzation techniques, which are beneficial from a human health and environment perspectice, and may also be economically advantageous in reducing the cost of application of methyl bromide. We are currently working with relevant industry groups to collect more accurate data on methyl bromide usage, identifying research programs, and selecting methods to improve sealing where it is techncially and economically feasible.

II. Dried Beans

Question 2. On the basis of discussions with California fumigators, MBTOC believes that if beans are listed on the California phosphine label and the location is otherwise suitable for phosphine fumigation, then phosphine would seem to be approved for dried beans in California, regardless of whether they are infested with cow pea weevil or another pest. MBTOC requests that USG obtain an interpretation of the approval to use phosphine for dried beans from State of California. Phosphine is used for this same purpose in the United States.

ANSWER:
Originally the U.S. believed there were two reasons why the California Bean Shippers Association had a critical need for methyl bromide. They could not meet the sanitation requirements in a timely fashion with phosphine (because of the extra time to treat the beans) and some counties in California would not allow the use of phosphine on their key pests (regulatory constraint). Currently, the U.S. understands that there are no regulatory constraints on the use of phosphine. However, the problem of delays when using phosphine to treat the dried beans still exists.

In consultation with the California Bean Shippers Association, USG has determined that regulations in California no longer require that the pest be on the label. Therefore, it is now allowable to use phosphine on beans in California even though the cowpea weevil, the major pest affecting these beans, is not listed on the label. However, this does not change the fact that the longer time required for a phosphine fumigation (a methyl bromide fumigation requires 12 hours but a phosphine fumigation requires 72 hours) would necessitate additional fumigation capacity be installed.

Harvest season for garbanzos is June and July with an average of 10-15 truckloads (or approximately 2000 Cwt) delivered daily to each warehouse. Fumigation with methyl bromide is set to begin each day by 4 pm with completion by early morning the next day. The 12 hour time required to fumigate with methyl bromide is critical to keeping up with the truckloads of beans arriving from the harvest on a daily basis. Harvest season for blackeyes in California is September through November with an average of 10-15 truckloads (or 2000 Cwt.) delivered daily to each warehouse. In order to accept the blackeye harvest all of the garbanzo bean harvest must be fumigated, cleaned and graded by September.

To show the importance of the 12 hour fumigant, imagine harvest of garbanzos, a 7 day per week operation using a 72 hour fumigant. On Monday 2000 Cwt arrives and is set for fumigation at 4 pm that same day. With phosphine the treatment will not be complete until Thursday pm, 72 hours later. Harvest is continuing daily with now an additional 6000 Cwt of beans sitting and waiting to be fumigated. By the end of week two you would have an 18000 Cwt backlog. Using this cycle it would be impossible to have the garbanzo beans fumigated, cleaned, graded and stored prior to the start of the blackeye harvest.

If the use of methyl bromide is taken from these warehouses they would have to triple or quadruple their capacity for fumigation in order to accommodate the 36 -72 hours under optimal conditions required for phosphine. At the projected cost of $50,000 to build a fumigation chamber with the additional cost of $5,000 land costs per additional chamber at current market prices they are looking at a minimum, a half million dollar investment to use any product that requires more than 12 hours. At the current price of beans this would easily eliminate any profit margin, which in the current market is minimal. It would definitely in the case of these warehouses put them out of business.

In addition, shipments of both kinds of beans are made year round; however, the heaviest shipping months are October, November, and December as 60% – 90% of the blackeye beans are shipped to the Southeastern United States in time for New Year's celebrations. Shipments are based on customers demand frequently with only a 2-day notification from the buyer. It is impossible for the warehouses to treat with any thing more than a 12- hour fumigant. Until an alternative is registered in California that is a 12- hour fumigant, methyl bromide remains the only product that is technically feasible for this industry.

However, the California Bean Shippers Association has begun to work with Dow, now that California has registered Profume®, to test sulfuryl fluoride in this industry. The industry is concerned about adequate egg kill as this is critical to keeping their product clean. In addition the fumigation treatment time will have to meet the needs of the bean industry to meet receiving and shipment requirements. The industry is planning to test reducing treatment time by increasing the rates which could conceivably make it competitive with methyl bromide. This however will come at an increased cost of product that may make it economically not feasible for this industry. The California Bean Shippers Association will be looking at both the rate of egg kill and comparing the actual costs of fumigation in their upcoming studies. Although this applicant does not yet have the results of these investigations they are hopeful that this product will work for them, but they will still need time to transition.

III. Dried Fruits and Nuts

Question 3. As the CUN indicates, adoption of gas forms of phosphine in this sector and in the State of California is very significant and is proceeding very quickly. Furthermore, MBTOC's information gathering indicates it is likely that the main pistachio processor will be 85% converted to phosphine by 2007. It is difficult therefore for MBTOC to interpret the need for MB in this instance as critical when a technically effective and commercially adopted alternative is in use in a very high percentage of operations in the same sector in the same state. MBTOC therefore has difficulty finding that this CUN fully complies with the requirements of Decision IX/6. However, USG may wish to correct this impression with data from the sector if MBTOC is incorrect.

ANSWER:
The California Pistachio Commission has indicated that phosphine is actually their fumigant of choice. However, when the weather cools, it can take many days to fumigate and de-gas with phosphine, up to 10 days. Additionally, processors can get an order that needs to be filled within 3-4 days, which does not allow for phosphine due to the increase in time required. It is under these conditions that methyl bromide becomes critical for meeting the market demands.

In addition, it is also a matter of staging areas. Paramount handles about 60% of the industry and within just a couple years that will mean about 250 million pounds of pistachios. If there are no fluctuations in shipping, 1 million pounds every business day need to be shipped. Use of phosphine exclusively would require that the industry have the capacity to have 10 million pounds of product in some stage of fumigation. So, while quick-turnaround orders are the most significant issue, general handling will continue to emerge as an issue.

Question 4. MBTOC also wanted to know if the dates included in the CUN were dried or were fresh moist dates. MBTOC has not yet identified an alternative to fresh moist dates, but there are alternatives for dried dates. Unless we are mistaken, dried dates do not seem to be under time-sensitive marketing pressure, so phosphine could be used.

ANSWER:

Although California dates are usually thought of as another dried fruit, they are not. The USDA and Perishable Agricultural Commodities Act consider harvested dates as fresh and their regulations describe them as such. When harvested they have about the same moisture as when they are packed – (15 - 23%). California Dates are not dehydrated as raisins (dried grapes) or as prunes (dried plums). Only a small proportion of fruit is dehydrated for diced dates and other by-products but this takes place after this fruit has been fumigated when it was newly harvested.

Actually, timing is critical to the California dates, whether fresh or dried. Harvest of dates in California begins in late September and early October, but the peak harvest occurs in November and early December. The dates are fumigated first, then processed, then shipped to customers. With methyl bromide this period takes 2 weeks, with the first harvest reaching store shelves by late October, and the last harvest by the end of December. Using phosphine adds an additional week to this timetable, so that the first harvest misses late October and the last misses end of December, thereby missing the holiday cooking season.

There is also an economic burden associated with phosphine. Because phosphine requires a longer fumigation, there would be a need for additional bins to handle the dates that have to be continuously harvested. Similar to the case with beans, there would need to be additional fumigation chambers built, with the additional land costs, labor costs would increase to handle the additional bins, and the date packaging plants would miss the target windows at both the beginning and the end of the U. S. holiday baking season.

Question 5. MBTOC believes that by giving an 'Unable to Assess' evaluation at this time, USG would have time to reassess its needs for this sector, both in terms of which commodities were included and the amount of MB that is requested for each sector.

ANSWER

As we have explained in the answers to questions 3 and 4 above, we do not believe additional time is needed for the USG to assess need in this sector. The U.S.Government endeavors to provide the best possible information and expert judgement to MBTOC so that MBTOC can make an informed recommendation. We have put forward our nominations this year because of a conscious choice to seek clearcut MBTOC recommnedations and decisions from the Parties by the end of 2005. We do this, among other reasons, because we have our own domestic regulatory system that involves full notice and comment public participatory rulemaking as part of the process of making domestic allocations of methyl bromide. We therefore request that given the responses to the substantive questions above, we be provided with a recommendation for this sector. It is also important to note that as part of that domestic rulemaking process, the U.S. Government does take into account additional information on changes in circumstances before allocating amounts of methyl bromide. This is accomplished through our notice and comment rulemaking process. As explained (below) as part of this process there is provision for the publc to comment on all data and assumption used in a rulemaking. All significant comments must be addressed. This requirement is judicially enforceable.

IV. Dried Commodities -Cocoa

Question 6. In other years MBTOC has received CUNs from Parties where all or part of the CUN looked like it might be a QPS application. QPS uses do not fit into the critical use nomination process and so similar to the other cases we have dealt with, MBTOC has sent this CUN back for further consideration by the Party. In this instance, MBTOC wonders if the segment of US cocoa imports that are required by USFDA to be treated under official control should be considered QPS treatments. Using the most recent year of US import statistics, and using the most recent list of countries on the US FDA mandatory treatment list, this would be about 30% of cocoa bean imports. If so, the CUN nominated amount would be considerably decreased. An 'Unable to Assess' nomination at this time gives USG some time to make a determination on this issue.

The CUN does not contain a lot of information about the logistics of cocoa bean import, treatment and storage. Although MBTOC has reviewed the paper by Marcotte and Sansone (2005), it too is lacking information about the ability, or not, to use phosphine on cocoa beans destined for long term storage or for re-fumigations of long term stored cocoa beans. Since phosphine is used for cocoa beans in many countries, MBTOC considers phosphine to be a technically effective alternative; whether it is economically feasible and could be commercially adapted in the US context are outstanding questions.

The response to questions obtained from the USG indicates cocoa beans are MB treated only once in the US but this does not appear to be consistent with interviews from the cocoa merchants and warehouse managers. Cocoa in the US is apparently treated first on import and then second, before shipment to chocolate manufacturers. It can also be treated more than twice if re-infestation happens in certain warehouses. Since any treatment of cocoa beans by MB is one of MBTOC more contentious issues faced by MBTOC, MBTOC finds it difficult to justify repeated fumigations by MB. The paper by Marcotte and Sansone contained some recommendations that might assist USG to work with the cocoa bean marketing channel partners to reduce MB refumigations and reduce the amount in the nomination. Alternatively the USG may wish to clarify this issue further.

ANSWER:
The U. S. Government has reviewed the circumstances of the cocoa nomination and believes this use does not qualify for methyl bromide under the QPS exemption. An automatic detention is mandated by US FDA; however it is not for a quarantine pest, nor is methyl bromide the specified fumigant. Therefore, USG does not think this meets the QPS exemption requirements. US FDA orders detention of adulterated beans and then leaves it to the owner to propose a remediation method. There does not yet appear to be other feasible fumigation treatments at this time.

Cocoa beans are typically fumigated with methyl bromide twice. The beans are usually infested with pests while in the hold of a ship; therefore, the beans are always fumigated when they come off the ship. Then the cocoa beans are usually fumigated at least one more time just before they go to the chocolate manufacturing facility. The primary difficulty is the warehousing. Most warehouses at the docks are old, constantly being reinfested with pests from the ships coming into port, and loaded to the rafters with cocoa beans. Although all the warehouses are certified by the Cocoa Merchants' Association, this certification does not mean that a warehouse has separate staging areas for new product or that the newly arriving product is sufficiently sealed off from existing (stored) product so as to eliminate the possibility of reinfestation.

Although phosphine is labeled for cocoa beans, there are label restrictions that limit its use in these warehouse situations. Phosphine label instructions do not permit use of a warehouse while beans are under gas. The exposure period for phosphine is generally 72 hours, plus 1-2 days for aeration, which shuts down a warehouse for 5 days or so. When methyl bromide is used, the fumigation is on Friday night, aeration begins Saturday night and the warehouse is open again on Monday morning. If phosphine were used for fumigation, shipments of beans could not go in or out for periods of 5 days at a time as the warehouse would be closed for this entire period. In addition, the industry would be limited in colder weather, as phosphine cannot be used at temperatures below 40° F, and requires longer fumigation time at lower temperatures.

V. Food Processing Facilities

Question 7. First, the critical need for MB use in bakeries has not been well justified. Little data has been submitted by USG to MBTOC to support the critical need for MB and the lack of technical availability or economic feasibility of the main alternative, heat. Bakery ingredients and foods cannot be heat treated but neither can they be MB treated.

ANSWER:
The critical need for MB and information on the technical and economical feasibility of alternatives for bakeries does not differ significantly from information already submitted on the subject for mills, pet food, rice mills, or other similar food handling facilities.

Although heat treatment is very effective in inactivating insects, it is not without significant risks. Its best application is in a controlled room environment, with a "temperature safe" structure, with the absence of electronic and heat sensitive equipment. In medium to large food plants the use of heat may not be practical and may not be economically feasible. Here are a few key points illustrating the limitations:

- For successful use of heat, expensive equipment which contains sophisticated electronics should be removed from the area to be heated. Although some equipment can be purchased that is capable of withstanding higher temperatures, some existing equipment is not so rated. In addition many electronic controls are used in the modern plant and if these are exposed to elevated temperatures or hot spots the likelihood of a startup failure is possible.
- Hot Spots. In large food plants with high ceilings and large floor spaces there can be areas to be treated that are up to 2.5 million cubic feet. Although this is not typical, areas even one half this size are a challenge to heat evenly, regardless of extra fans and other equipment that could be used to assure a controlled heat up. Hot spots can result in damage to buildings. Also, some areas are not well insulated and in some cases have windows with limited insulation capability making maintaining heat at insect control temperatures impractical or even impossible.
- The time required for heat treatments is another concern. Even if heating / heat up is done by a contractor, the time to heat the facility safely without concern for structural damage is not reasonable. The general rule is that you should not exceed temperature increases or decreases of ten degrees per hour, which if you would elevate from a base temperature of 70 F to 140F would take 7 hours to heat the facility with an abundance of heat but more likely it takes 7 hours to gain

that temperature from 115 to 140F. More of a challenge is the cool down which takes considerable time to assure that the facility can be cooled for employees to be able to return to these areas to work. The other obvious concern is the cost of heat (BTUs) to heat a facility.

- Prior to any heat treatment each facility must go under a structural review by an engineering firm to be assured that the facility is capable of withstanding the variations in temperatures typical for a successful insect kill. In many cases enhancements are needed to assure that damage will not be sustained during the treatment. Large facilities have been shown to need significant upgrades which require large capital investments (e.g. roof replacement). Additionally the long term impact of heat is not known, especially of older facilities which are not designed for exposure to elevated temperatures.
- Electrical components and wiring are a concern as well. The National Electric Code speaks to derating of electronic wiring at elevated temperatures. Derating of circuits which must remain active during heat treatments can result in circuit overload unexpected shut down of equipment. Efforts can be made to protect some electrical components but wiring cannot be upgraded to compensate for derating without tremendous expense. Unplanned shut down of equipment is extremely costly and therefore is not acceptable from a business perspective.
- The retrofitting of older facilities can be economically prohibitive. Incorporating new sprinkler systems, electrical components and wiring, and other building components to withstand heat fumigations can be very expensive.

The statement that bakery ingredients and foods cannot be treated with methyl bromide is inaccurate. US regulations at 40 CFR (Code of Federal Regulations) 180.123(a)(2)(i) do permit residuals of inorganic bromide resulting from fumigations with methyl bromide. In the US, methyl bromide is labeled for use on processed foods, However, the bakery applicants did not request methyl bromide for use on their ingredients or processed foods, only for their structures.

Question 8. The amount of MB used in bakeries places it as the second highest post-harvest use of MB world wide, second only to US mills, yet the CUN does not present information on emissions control aspects for bakeries, research on alternatives, adoption of heat treatment in bakeries or justification for MB use in bakeries, and especially for an increase in use. There is more MB requested for US bakeries than for several US pre-plant uses, yet there is an extensive US research program for those soil uses.

ANSWER:
There is research information in the "Structures—Food Facilities" " submission from the USG pertaining to bakeries, this is the only chapter from the U.S. that includes bakeries. The increase in the nomination amount is to provide methyl bromide to facilities where alternative treatments have been tested and shown not to effectively control the target pests.

Question 9. MBTOC is also concerned that since there are two US CUNs including bakeries, USG might not have considered the extent of use of MB for bakeries, and including an apparent increase in this sector.

ANSWER:
The USG nomination for bakeries is only in the "Structures-Food Facilities" chapter. The "Post-Harvest-NPMA" sector does not include bakeries. The "Post-Harvest-NPMA" chapter does include

some processed foods and their facilities, but the main difference is that it has included the treatment of the processed foods in the nomination. With regards to heat, most processed foods and their ingredients cannot be heat treated simply because heat does not penetrate well, especially through dense material such as processed flour. A research trial conducted on pasta revealed that heat penetration through a tote of product would require close to seven days for full penetration during which time condensation inside packaging became a problem. In addition, subjecting certain ingredients or food items to high heat can affect their baking quality or cause degradation of the material

Question 10. MBTOC has been presented with information from the supplier of heat treatment equipment telling us that heat treatments have been successful in bakeries. In the absence of data indicating otherwise, MBTOC is considering whether heat treatment should be technically and economically feasible for many bakeries, and therefore whether MB treatment for bakeries fully complies with Decision IX/6. It is possible that USG would wish to correct us on this point by providing detailed sector-specific information on the technical and/or economic infeasibility of heat treatment or other alternatives. MBTOC needs more detailed information about this sector, the need for MB, valid reasons by heat can not be used as a disinfestation treatment for bakeries, research on alternatives in bakeries, IPM measures in bakeries to decreased the frequency of fumigation and how bakeries are sealed for MB treatments to ensure overall low MB use.

ANSWER:
Many valid concerns are associated with the use of heat treatments in bakeries or similar food handling facilities. Chief among the concerns is the economic feasibility of heat treatments. In a recent assessment by a bakery company, restructuring for heat treatments (to eliminate the use of MB) was estimated to average 3 million US dollars per facility The engineering firm assessing the structures examined boiler capacity, building structure, roof material replacements, sprinkler system upgrades, PLCs moved or cooled, and numerous other items. In addition to restructuring costs, there is the cost associated with the actual heat treatment. Heat treatments typically need to be scheduled on a more frequent basis than a MB fumigation which leads to additional downtime costs. Companies that contract heat treatments typically spend two to three times the cost of a MB fumigation

The lack of long term studies of heat stress caused by expansion and contraction over repeated heat treatments has not been the subject of research by those who purvey heat treatments for financial gain. There has been the expectation, by some, that because heat can kill insects that it should be accepted as an alternative to methyl bromide without full consideration of the potential negative effects upon structures and electrical components and wiring in food plants.. It is a fact that electric wiring when utilized during periods of high temperature, such as heat treatment, is “derated” meaning, in effect, that it loses capacity. Such loss may render the electrical circuit in violation of the National Electric Code and may overload circuits resulting in shut down of plant systems. Although efforts can be taken to protect sensitive electronic systems and minimize their use during heat treatments, it is not predictable that facilities would be able to always adequately protect or limit use (in particular, the effects of structural wall movements and derating on electrical wiring). Electrical wiring that is derated by heat over time has the potential to cause wiring to carry less current. Additionally, damage to wire insulation over time due to heat stress may not be noticed and has the potential for arcing between wires which can result in fire or explosion hazards

Although heat treatment is very effective in inactivating insects, it is not without significant risks. Its best application is in a controlled room environment, with a "temperature safe" structure, with the absence of electronic and heat sensitive equipment. In medium to large food plants the use of heat may not be practical and may not be economically feasible. Here are a few key points illustrating the limitations:

- For successful use of heat, expensive equipment which contains sophisticated electronics should be removed from the area to be heated. Although some equipment can be purchased that is capable of withstanding higher temperatures, some existing equipment is not so rated. In addition many electronic controls are used in the modern plant and if these are exposed to elevated temperatures or hot spots the likelihood of a startup failure is possible.
- Hot Spots. In large food plants with high ceilings and large floor spaces there can be- areas to be treated that are up to 2.5 million cubic feet. Although this is not typical, areas even a half this size are a challenge to heat evenly, regardless of extra fans and other equipment that could be used to assure a controlled heat up. Hot spots can result in damage to buildings. Also, some areas are not well insulated and in some cases have windows with limited insulation capability making maintaining heat at insect control temperatures impractical or even impossible .
- The time required for heat treatments is another concern. Even if heating / heat up is done by a contractor, the time to heat the facility safely without concern for structural damage is not reasonable. The general rule is that you should not exceed temperature increases or decreases of ten degrees per hour, which if you would elevate from a base temperature of 70 F to 140F would take 7 hours to heat the facility with an abundance of heat but more likely it takes 7 hours to gain that temperature from 115 to 140F. More of a challenge is the cool down which takes considerable time to assure that the facility can be cooled for employees to be able to return to these areas- to work. The other obvious concern is the cost of heat (BTUs) to heat a facility.
- Prior to any heat treatment each facility must go under a structural review by an engineering firm to be assured that the facility is capable of withstanding the variations in temperatures typical for a successful insect kill. In many cases enhancements are needed to assure that damage will not be sustained during the treatment. Large facilities have been shown to need significant upgrades which require large capital investments (e.g. roof replacement). Additionally the long term impact of heat is not known, especially of older facilities which are not designed for exposure to elevated temperatures.
- Electrical components and wiring are a concern as well. The National Electric Code speaks to derating of electronic wiring at elevated temperatures. Derating of circuits which must remain active during heat treatments can result in circuit overload unexpected shut down of equipment. Efforts can be made to protect some electrical components but wiring cannot be upgraded to compensate for derating without tremendous expense. Unplanned shut down of equipment is not acceptable from a business perspective.
- The retrofitting of older facilities can be economically prohibitive. Incorporating new sprinkler systems, electrical components and wiring, and other building components to withstand heat fumigations can be very expensive.

Question 11. In pet foods, heat treatment is used in 20% of the pet food establishments according to the CUN. MBTOC is concerned that this adoption shows that heat is technically available and economically feasible, in the absence of data from USG showing otherwise. MBTOC members are aware that at least one large US pet food manufacturer relies entirely on spot heat treatments and has done so for several years. MBTOC acknowledges the reality that US legislation requires the same approvals and sanitation standards for pet foods as is required for human foods, but the CUN does not adequately justify the need for MB for pet foods. MBTOC has not been presented with detailed information about the facilities included in this sector (Manufacturers? Warehouses? Retail establishments?), the need for MB, valid reasons why heat can not be used, research on alternatives for pet food establishments, IPM measures, and how pet food establishments are sealed to ensure overall low MB use.

ANSWER:
This is correct, approximately 20% of PFI (Pet Food Institute) plants use heat treatment. However, not all plants are suitable for heat treatments due to their construction (e.g. wood), geographic locations (colder climates), or the presence of finished products or ingredients that would be damaged by high heat. With regard to the major manufacturer that relies on heat, clearly there are portions of some facilities in certain areas containing certain products that are suitable for heat treatment. USG assumes the use of the word "spot" in MBTOC's statement refers to heat treatments in specific areas of a pet food facility. Heat, therefore, is one of many IPM tools, as is methyl bromide, but heat is not completely suitable for all areas or all plants.

USG thinks that the CUN does adequately justify the critical need for methyl bromide in pet food manufacturing facilities. In addition to government requirements that pet food products be free of insects, pet food consumers have a zero tolerance for any insect contaminants. For example, under many contractual arrangements, pet food manufacturers are required to compensate retailers for not only the cost of an insect-contaminated product but also the profit from the lost retail sale. In addition, PFI survey research has indicated that insect contamination in a pet food product is a top consumer concern. Also, pet food is in many cases a branded product. That brand name has substantial value. Insect contamination in a pet food product has the potential to cause substantial loss of market share and could permanently damage the brand.

PFI represents the companies that produce approximately 99 percent of the commercial dog and cat food sold in the United States. This information has been presented in each and every application since the start of this process. The facilities in question are located in 37 states across the country and range in age from less than five years to older than one hundred years. None of these production facilities is associated directly with a retail establishment on the property. Many, if not all, do have a warehouse or some form of storage facility connected with or adjacent to the production area.

In addition to the responses above, PFI is committed to improving pest management at member facilities. All PFI members constantly strive to maintain a pest-free environment in their production locations. Better sanitation, chemical spot treatments, traps, insecticutors, and structural repair are all used to prevent infiltration by insects and to reduce the need for methyl bromide. However, there still exists the need to fumigate entire facilities. Heat treatment is not completely suitable for all facilities but research will continue. Other research is focused on insect growth regulators embedded into product packaging.

Despite this research and all pest management practices there is still not a technically and economically viable alternative to periodic methyl bromide fumigation for those facilities in our nomination.

Question 12. In the category 'Other' included in this CUN are several commodities that can be phosphine treated. MBTOC needs to know why they cannot be phosphine treated in these particular instances. Are these commodities treated with MB as a result of infestation found at import, or is there some other reason that a fast treatment by MB is required instead of phosphine?

ANSWER:
Fumigants of choice for treating spice commodities are ETO, PPO, and phosphine; however, a very small percentage of spices are fumigated with methyl bromide. The majority of spice commodity fumigations with MB are for quarantine or pre-shipment requirement. Facilities that have an occasional need for fumigation can not justify the cost associated with vacuum chambers or irradiation methods (example: occasional trailer fumigation every few years) and are using methyl bromide due to time constraints associated with phosphine. Time constraints for one company are due to demurrage fees of $200/day associated with overseas containers.

Question 13. In the category 'herbs and spices', MBTOC seeks assurance that the MB is required for facilities and equipment and not herb and spice commodity. There are alternatives available for herb and spice commodity.

ANSWER:
The request for methyl bromide is for the facilities where spices are blended into packages (such as for pizza mixes) that are then added to pre-packaged goods. These facilities are similar to grain mills in that there are silos, mixing areas, packaging areas, etc. Infestation in herb and spice blending facilities is not localized to machinery that can be spot heat treated. These facilities utilize methyl bromide to target pests present in inaccessible areas of the structure, not the ingredients or finished products that may be stored on-site.

Fumigants of choice for treating spice commodities are ETO, PPO, and phosphine; however, a very small percentage of spices are fumigated with methyl bromide. The majority of spice commodity fumigations with methyl bromide are for quarantine or pre-shipment requirement. Facilities that have an occasional need for fumigation can not justify the cost associated with vacuum chambers or irradiation methods (example: occasional trailer fumigation every few years) and are using methyl bromide due to time constraints associated with phosphine. Time constraints for one company are due to demurrage fees of $200/day associated with overseas containers.

VI. Mills and Processors

Question 14. Our comments about bakeries in the CUN discussed above also apply to the over 23 tonnes of MB requested for bakeries in this CUN

ANSWER:
Although heat treatment is very effective in inactivating insects, it is not without significant risks. Its best application is in a controlled room environment, with a "temperature safe" structure, with the absence of electronic and heat sensitive equipment. In medium to large food plants the use of heat

may not be practical and may not be economically feasible. Here are a few key points illustrating the limitations:

- For successful use of heat, expensive equipment which contains sophisticated electronics should be removed from the area to be heated. Although some equipment can be purchased that is capable of withstanding higher temperatures, some existing equipment is not so rated. In addition many electronic controls are used in the modern plant and if these are exposed to elevated temperatures or hot spots the likelihood of a startup failure is possible.
- Hot Spots. In large food plants with high ceilings and large floor spaces there can be- areas to be treated that are up to 2.5 million cubic feet. Although this is not typical, areas even a half this size are a challenge to heat evenly, regardless of extra fans and other equipment that could be used to assure a controlled heat up. Hot spots can result in damage to buildings. Also, some areas are not well insulated and in some cases have windows with limited insulation capability making maintaining heat at insect control temperatures impractical or even impossible .
- The time required for heat treatments is another concern. Even if heating / heat up is done by a contractor, the time to heat the facility safely without concern for structural damage is not reasonable. The general rule is that you should not exceed temperature increases or decreases of ten degrees per hour, which if you would elevate from a base temperature of 70 F to 140F would take 7 hours to heat the facility with an abundance of heat but more likely it takes 7 hours to gain that temperature from 115 to 140F. More of a challenge is the cool down which takes considerable time to assure that the facility can be cooled for employees to be able to return to these areas- to work. The other obvious concern is the cost of heat (BTUs) to heat a facility.
- Prior to any heat treatment each facility must go under a structural review by an engineering firm to be assured that the facility is capable of withstanding the variations in temperatures typical for a successful insect kill. In many cases enhancements are needed to assure that damage will not be sustained during the treatment. Large facilities have been shown to need significant upgrades which require large capital investments (e.g. roof replacement). Additionally the long term impact of heat is not known, especially of older facilities which are not designed for exposure to elevated temperatures.
- Electrical components and wiring are a concern as well. The National Electric Code speaks to derating of electronic wiring at elevated temperatures. Derating of circuits which must remain active during heat treatments can result in circuit overload unexpected shut down of equipment. Efforts can be made to protect some electrical components but wiring cannot be upgraded to compensate for derating without tremendous expense. Unplanned shut down of equipment is not acceptable from a business perspective.
- The retrofitting of older facilities can be economically prohibitive. Incorporating new sprinkler systems, electrical components and wiring, and other building components to withstand heat fumigations can be very expensive.

The statement that bakery ingredients and foods cannot be treated with methyl bromide is inaccurate. In the US, methyl bromide is labeled for use on processed foods. US regulations at 40 CFR (Code of Federal Regulations) 180.123(a)(2)(i) do permit residuals of inorganic bromide resulting from fumigations with methyl bromide. However, the bakery applicants did not request methyl bromide for use on their ingredients or processed foods, only for their structures.

Question 15. The CUN requests MB for 2007, in 2005. Our secondary reason for giving this CUN an 'Unable to Assess' was our belief at the meeting in Argentina (April 2005) that sulfuryl fluoride approval for mill applications in California was imminent. California approved SF for mills in May 2005. MBTOC is aware that a large California rice mill was booked for SF test fumigation immediately following the California approval and other millers would be watching this treatment with considerable interest. Licensed fumigators in California have already been trained and are ready to begin assisting mills with adoption, MBTOC could not recommend an MB amount for 2007 knowing that a major user sector would soon have access to an acknowledged alternative.

ANSWER:

It is correct that SF was registered for certain uses by the State of California in May 2005. California is, therefore, approximately 18 months less experienced in conducting SF fumigations. This is important as evidence from successful fumigations is likely to be persuasive in facilitating adoption of this alternative. As illustrated by the submission (below) from the one experience in a California rice mill, may facilities will require some repeat experience before they are comfortable concluding that SF is an appropriate alternative to fumigation with methyl bromide. The issue of cost differences, and thus economic feasibility, is still outstanding. USG has only been able to get information from one rice mill in California that used sulfuryl fluoride for a full fumigation using a 20-year veteran fumigator. This appears to be the first and only commercial application of Profume in that state. The mill operator has the following comments:

“Efficacy--Gauging by pest traps placed inside, appeared to be equivalent (100% kills in traps) to Methyl Bromide (MeBr) however this is the only fumigation using Profume that they have done. They don't have knowledge of efficacy on pest eggs. Costs--Down time for the mill was longer than for Methyl Bromide, Material cost was substantially higher than the cost of MeBr, Setup costs were higher due to the computer-monitoring points and piping required for Profume. Structure--The mill is a new slip-form concrete mill, designed for easy fumigation (better sealed than older architecture). Comments: Computer-controlled monitoring worked as advertised and applied product where needed in the structure. It was easier to ventilate. Has smaller (state-required) non-occupied buffer zones. Was more costly than MeBr. Profume cannot replace MeBr's primary use in export containers because it permeates through the wooden container floors. Was used in a new, fumigation-friendly mill. Does not know how it will work in older mills.” The miller was encouraged but not convinced. He was not 100% satisfied. He requires more experience with it to determine if it can be a true replacement for MeBr.

Question 16. MBTOC needs to see how this sector will adopt SF, continue to adopt heat, make IPM improvements to decrease MB fumigation frequency and improve sealing to decrease overall use. We believe a USG reassessment of these factors may result in a different amount of MB nominated for this sector.

ANSWER

As MBTOC is aware the National Management Strategy will be provided to the Parties by February 2006 and we anticipate that many of these questions will be addressed in that document. The U.S.Government endeavors to provide the best possible information and expert judgement to MBTOC so that MBTOC can make an informed recommendation. We have put forward our nominations this year because of a conscious choice to seek clearcut MBTOC recommnedations and decisions from the Parties by the end of 2005. We do this, among other reasons, because we have our own domestic regulatory system that involves full notice and comment public participatory rulemaking as part of the process of making domestic allocations of methyl bromide. We therefore request that given the responses to MBTOC's substantive questions, we be provided with a recommendation for this sector. It is also important to note that as part of that domestic rulemaking process, the U.S. Government does take into account additional information on changes in circumstances before allocating amounts of methyl bromide. This is accomplished through our notice and comment rulemaking process. As explained (below) as part of this process there is provision for the publc to comment on all data and assumption used in a rulemaking. All significant comments must be addressed, and this requirement is judicially enforceable.

In the US there is a process in place to take into account newer information in determining the amount of methyl bromide that will be allocated to critical needs. A requirement before any production to import of methyl bromide for critical uses can take place is that the proposal to allow it be put before the public in a notice and comment rule-making. During this open and transparent process the public has the opportunity to comment on all aspects of the proposed rule. It is also a requirement, enforced by judicial review, that all significant comments must be addressed. If the situation with respect to availability and technical and economic feasibility of alternatives changes between the time that the Parties make a decision (in response to a MBTOC recommendation) and the time that the USG proposes its allocation amount, that proposal can take those changes into account. If it does not do so, the public (probably in the form of manufacturers of alternatives and environmental groups) will comment that the need for methyl bromide is less than had been the case when the decision was made by the Parties and that, therefore, the allocated amount should be lower. If this comment is not addressed, members of the public can seek to have a court invalidate the rule. This 'notice and comment' requirement is a powerful tool for incorporating new information into the internal allocation process. It acts to ensure that changes in the status of alternatives are taken into appropriate account

Question 17. Concerning flour mills, MBTOC knows that adoption of SF and/or heat treatment is continuing, although slower than the registrant or heat equipment suppliers would prefer, and slower than they tell us. MBTOC acknowledges the economic arguments presented in the CUN concerning costs of heat treatment in flour mills. However, MBTOC has also conducted many interviews with millers and fumigators. We see that USG's has reduced the 2007 CUN requested amount by about 15% and we believe that a 15% per year adoption level in the flour milling sector is quite likely. We do not have further questions for flour mills.

But as we indicated above, that 15% adoption level did not include the possibility of adoption of SF in California and we are seeking new data on adoption levels and possible revision of the nominated quantity for this CUN.

ANSWER

The USG continues to use the best information we have available and our expert judgment in assessing our need for methyl bromide. As new information is developed and circumstances change, we are committed to accounting for it. With respect to the change in the registration status of SF in California, we have not had adequate time to collect relevant data and analyze it to assess how it might change the nominated quantity for this CUN for 2007. The shifting local, state and federal regulatory requirements have made the process of analyzing our need for methyl bromide extremely burdensome. However, we are currently in the process of developing our domestic 2006 CUE allocation rule by which methyl bromide is made available to those users that qualify for them. As part of that process, the USG will seek additional information relevant to assessing the impact of this registration, and having obtained better information will assess the impact of this new registration on our need for methyl bromide in 2006. Such an analysis will also be applied as part of our domestic allocation process for 2007 CUEs.

Appendix I—Sulfuryl Fluoride Case Studies in Flour Mills

These data were provided to the USG and are a fumigating company's actual estimate of the cost to fumigate a mill with MB or SF. These estimates are based on targeting all life stages of the red flour beetle and the confused flour beetle. These estimates are illustrative of the significant difference in cost that may be faced by some facilities. We recognize that the cost differential in this estimate does not apply to all facilities, but the data nevertheless do demonstrate the significant economic impacts that some facilities may face with respect to the use of SF as a methyl bromide replacement.

ASSET UTILIZATION

U.S. grain mills are under intense economic pressure. Profit margins are razor-thin or non-existent. Elimination of costs is the number one priority. Likewise, customer industries are also working to eliminate costs. This has resulted in a move toward 'just in time' delivery whereby inventories are reduced and deliveries are more frequent. At the same time, the customer's expectations for high quality, insect-free products are nonnegotiable.

An industry operating on a 5 day schedule would have less difficulty completing downtime activities like fumigation as those tasks could be scheduled during weekends. To optimize efficiency, however, the milling industry must operate 24 hours per day for 6 days a week, and often operates round-the-clock 6.5 or 7 days per week. Downtime must be minimized as every hour the mill is out of production is an hour's revenue that can never be replaced.

The cost of lost revenue can be startling. For example, an average flour mill in the US produces about 1.0 million pounds each day. The sales price of industrial or non-retail milled grain products is about $0.12 per pound. So, an additional day of downtime results in lost revenue of $120,000 that, again, can never be replaced in an industry striving for 24-7 operation.

With the trend of low carbohydrate fad diets abating, consumption of grain-based foods is increasing. This will result in a corresponding increase in run-time (production) and additional pressure to minimize downtime.

CHOOSING THE RIGHT ALTERNATIVE

As stated earlier, time is valuable and currently available alternatives require lots of preplanning. Whatever treatment is chosen, it must be effective the first time as there will be little time to repeat or 'redo' the treatment. Efficacy and downtime must be balanced, i.e. sufficient time must be allowed for slower acting alternatives to work, while still fitting into the (increasingly smaller) time window.

Success will also be impacted by inadequate preparatory cleaning, structural limitations, low temperatures that reduce pest respiration and life stages of target pests.

Sulfuryl fluoride (SF)

The adoption of SF as a replacement for MB has been hindered by 3 types of hurdles – legal, technical and economic. Significant legal hindrances include:

1. very few international tolerances, precluding the use of SF in facilities when products may find their way into export channels.
2. No tolerances on enrichment – the niacin, thiamine, riboflavin, iron and folic acid fortifications that are added to milled grain products
3. No tolerances on ingredients such as sugar, oil, spices, etc. which precluded the use of SF in facilities where ingredients might be present
4. A label restriction which required flour exposed to SF be blended into non-exposed flour in a 10:1 ratio (treated: untreated)

Important progress has been made on several of these hurdles. SF recently received tolerances on enrichment and ingredients, and the flour blending requirement has been dropped. Those new tolerances have yet to be registered by the states, but if and when they are it will be an important milestone achieved. The lack of international tolerances continues to be a legal hurdle.

When the legal hurdles are removed, technical and economic hurdles will remain. Industry experience thus far has been that SF does not compete technically or economically with methyl bromide.

These hurdles are briefly described in the following, real world examples. This is not intended to be an exhaustive list, rather it is a snapshot of the experiences described by milling companies.

Example 1
These data were provided to the USG and are a fumigating company's actual estimate of the cost to fumigate a mill with MB or SF. These estimates are based on targeting all life stages of the red flour beetle and the confused flour beetle. These estimates are illustrative of the significant difference in cost that may be faced by some facilities. We recognize that the cost differential in this estimate does not apply to all facilities, but the data nevertheless do demonstrate the significant economic impacts that some facilities may face with respect to the use of SF as a methyl bromide replacement

Size of mill: 1.3 million cubic feet
Assumed temperature: 82 F/28 C

Fumigation Price:

<u>Methyl Bromide</u> $18,500.00
24 hour exposure period
12 hour HLT (half loss time)
1,300 lbs. gas

<u>Sulfuryl Fluoride</u> $48,000.00
36 hour exposure period
7 - 9 hours HLT
5,250 lbs. gas

Example 2
In this example, the quantities of SF necessary to control red flour beetles in a 1.8 million cubic foot mill were calculated at 2 target concentrations. The mill is of modern, slip-form concrete construction and therefore represents a gas tightness much better than the average mill. For a 24-hour fumigation at 86 F/30 C, the quantities were:

- Sulfuryl fluoride – eggs not targeted 3125 lbs
- Sulfuryl fluoride - to control all life stages 5226 lbs
- Historical quantity of methyl bromide 1800 lbs
  used to control all life stages in this mill

At this point the impact of less than optimal temperature on the effectiveness of SF must be noted. At the same mill, managers dissatisfied with the first SF fumigation planned another attempt several months later. The temperature having dropped with the change of seasons resulted in an estimated quantity to control "all life stages" of approximately 13,000 pounds. All other considerations being equal, the miller would obviously have difficulty supporting a pest management regimen that requires a seven-fold increase in pesticide usage.

Pesticide usage encompasses multiple serious issues in addition to the immediate goal of technical and economic feasibility. These include worker safety, community right-to-know laws, residue tolerances on foods, general public concern about pesticides and others. As a result, the trend is toward pest management solutions that rely on <u>fewer</u> pesticides - not more.

The "less than all life stages" dosage targets the larvae, pupae and adult insects, but not the eggs. This is not a reasonable option for mills. The eggs that are not killed with this treatment will hatch in about 30 days. The mill must then be idled yet again for a follow-up fumigation. Therefore, the actual time to control all life stages at this dosage is 36-48 hours with a concurrent increase in lost revenue.

Example 3
In this example, a mill and warehouse were fumigated in May 2005. Sulfuryl fluoride was the principal treatment, with a few locations in the complex treated with either CO2 and phosphine in combination, or with a DDVP (dichlorvos) fog.

Live insect traps were distributed throughout the facility to provide efficacy data. The traps were checked at the conclusion of the fumigation, and again 30 days later. The results follow:

Floor	Location	Treatment	May 2, 2005	June 1, 2005
	Mill and Packing Department			
6	top of filter in cleaning house	sulfuryl fluoride	All dead	Live larvae
	top of air lock table in A mill	"	All dead	Live larvae
5	ledge on back wall in cleaning	"	All dead	All dead

	house			
	Top of air lock table in B mill	"	All dead	Live larvae
	In phone box in A mill	"	All dead	Live larvae
	On catwalk behind filter	"	All dead	All dead
	Top of #9 bin	"	All dead	Live larvae
	in sieve screen drawer	"	All dead	Live larvae
4	on catwalk in cleaning house	"	All dead	Live larvae
	in #1 filter room in B mill	"	All dead	Live larvae
	In phone box in A mill	"	All dead	Live larvae
	On top of packing bin under hatch door	"	All dead	Live larvae
	Inside sifter in B mill (closed)	"	All dead	Live larvae
	Inside packer rebolt sifter (open)	"	All dead	Live larvae
3	On ledge on back wall in cleaning house	"	All dead	Live larvae
	On purifier by stairwell in B mill	"	All dead	All dead
	In phone box in A mill	"	All dead	All dead
	In whole wheat roll stand in packing	"	All dead	Live larvae
	Inside wheat germ classifier	"	All dead	Live larvae
2	In locker in cleaning house	"	All dead	All dead
	In roll stand by locker in B mill	"	All dead	Live larvae
	In roll stand by window fan in A mill	"	All dead	All dead
	In whole wheat sifter on packing side	"	All dead	All dead
	On top of packer	"	All dead	All dead
	On floor in corner in room over packer	"	All dead	Live larvae
1	On ledge of back wall in	"	All dead	Live

	cleaning house			larvae
	On corner wall by drain in B mill	"	All dead	Live larvae
	On motor in cage in A mill	"	All dead	Live larvae
	In front warehouse corner	"	All dead	Live larvae
	Inside wheat germ hopper (open)	"	All dead	Live larvae
	Roll room	"	All dead	All dead
	On #4 bin hopper	"	All dead	Live larvae
	Warehouse			
	On top of palletizer	"	All dead	Live larvae
	On pallet in rack "P"	CO_2/phosphine in combination or DDVP fogging	All dead	Live larvae
	Shop			
1	On top of tool box	"	All dead	All alive
	Old warehouse by bakery office	"	All dead	All alive
2	In bakery office	"	All dead	Live adult
	By filter sock storage	"	All dead	All dead
	At wheat germ metal detector	"	All dead	Live adult
	By sifter sieve storage	"	All dead	All dead
	Filter sock storage area by break room	"	All dead	Live adult
	Bulk Plant			
6	On slide by bin #41	sulfuryl fluoride	All dead	All dead
	On ledge by bin #83	"	All dead	All dead
5	In #2 rebolt sifter	"	All dead	All dead
4	On catwalk at top of ladder	sulfuryl fluoride	All dead	All dead
	On top of scale bin	"	All dead	All dead
3	On whole wheat bin slide	"	All dead	All dead
	Man-lift area	"	All dead	All dead

2	On air lock of bin #82	"	All dead	Live larvae
1	On conveyor at bin #41	"	All dead	All dead

More than half of the traps contained live infestation a mere 30 days after fumigation.

Example 4
This example shows the cost to treat a 1.6 million cubic foot mill with heat. As is typical for most mills, heating capacity at this mill is insufficient to achieve insecticidal levels so an outside contractor was brought in.

•Cost of heat treatment	$25.74/1,000 cubic feet
•Historical average cost to fumigate this mill with methyl bromide	$15.00/1,000 cubic feet

Preparation	$45,943
Post heat treatment repair	$38,992
Net total cost for prep and repair:	$79.06/thousand cubic feet

Other operational considerations include
Also, milling equipment is not intended nor designed for high heat environments, and their manufacturers will not guarantee their performance. Exposure to high heat could void warranties. Likewise, it is known that high heat can cause structural damage to the facility. This raises significant safety concerns, liability issues and potentially jeopardizes insurance coverage.

SUMMARY

Proponents of MB alternatives will look at these examples and criticize their "doom and gloom" perspective. True, there are situations where alternatives have proven to be feasible. However, it is a reality that alternatives do not compete well with methyl bromide on an economical basis at the current time when they are attempting to take away market share from methyl bromide. If methyl bromide were not available, it would defy basic laws of economics if the alternatives were to suddenly become cheaper.

Said another way, a product that does not compete well on price in a free market is unlikely to be priced more competitively when it enjoys a (near) monopoly.

Regarding technical feasibility, the industry's understanding of the operational constraints associated with each alternative will improve. In fact, the industry has shown willingness to experiment with alternatives and share that information through its professional society. While the understanding of the strengths and limitations of an alternative will improve, the chemistry of the alternative itself will not change. If an alternative damages buildings or does not kill eggs today, those shortcomings are not going to change.

In conclusion, the USG believes a 15 percent adoption rate is aggressive but achievable and will not revise the nominated quantity for this CUN.

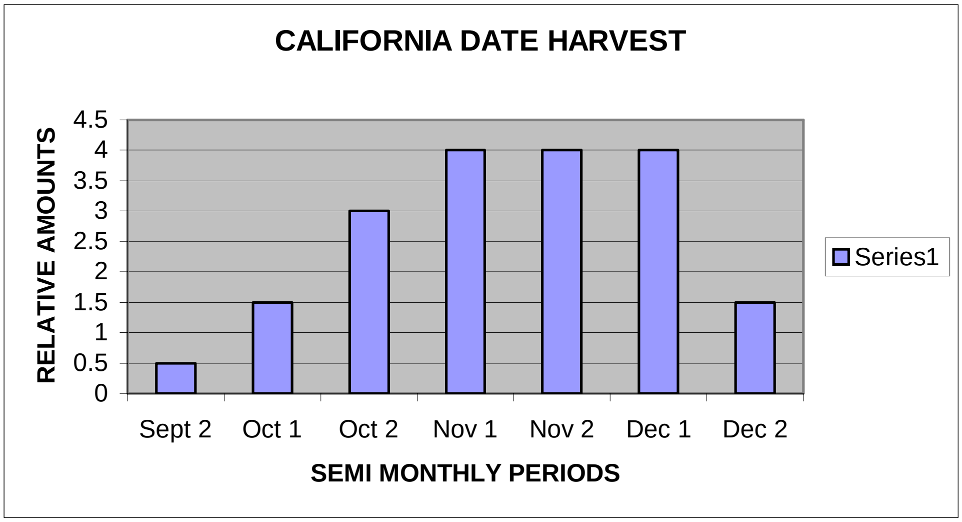
Appendix II—Timing limitation in using phosphine on California dates

The difficulties in using Phosphine to fumigate newly harvested dates effects the industry in two ways A; timing of harvest relative to peak market demand and B; the cost of extra equipment, labor and land necessary to make the transition.

A - TIMING OF HARVEST, FUMIGATION WITH PHOSPHINE, PROCESSING AND SALES OF CALIFORNIA DATES

1 Chart of harvest times
2 Schedule of fumigation rotation
3 Definitions
4 Expected market display dates for various harvest times.

1. Chart of harvest times



2 – Activity Schedule in fumigation rotation

Day	Activity
1	Build stacks - Cover with tarp, seal - Apply Phosphine
2	Fumigate – 24 hrs @ 6 pm
3	Fumigate – 48 hrs @ 6 pm
4	Fumigate – 72 hrs @ 6 pm
5	Uncover stack - Air out
6	Air out
7	Move fumigated bins – Build new stacks

3 - The following is a schedule of the typical timing of handling fresh California dates.

The time necessary to harvest dates and get them to be sold to the consumer is equal to;
time of harvest + fumigation time + processing time + shipping time

1) Harvest: A majority of the fruit is picked from the middle of October until the end of November or the first week in December

2) Fumigation time = 7 days

3) Processing time: Time from end of fumigation until the fruit is packed into sale containers. = 10 days

4) Shipping time: Time from being packed, through cooling, loading, shipping to customer and placed on display. This time is thought to end in early December for the fruit to be sold that holiday season. Time is 3 to 7 days

4 - Timing for in store display of dates by harvest time and method of fumigation:

	Date of earliest display in store	
Date of Harvest	**MBr**	**Phosphine**
Oct 16	Oct 30	Nov 6
Nov 1	Nov 15	Nov 22
Nov 16	Nov 30	Dec 7
Dec 1	Dec 15	Dec 22
Dec 16	Dec 30	Jan 7

B - SWITCHING TO PHOSPHINE – Cost of extra Equipment, Land and Labor.

1) Bin needs
2) Area needed to fumigate
3) Manpower needed
4) Additional equipment needed
5) Summary of Costs

The following information is for a typical large packer

1. Number of bins tied up in Phosphine fumigation rotation.

No. of Stacks/day	Lbs. of Dates	No. of Bins	No. of bins per Rotation
1	90,000	108	756
2	180,000	216	1512
3	270,000	324	2268
4	360,000	432	3024
5	450,000	540	3880

Footnote: 1 stack = 108 bins 1 bin = 833 lbs

2 – Area needed to fumigate with phosphine

2a - Accumulation of stacks

Day	No. of Stacks	No. of stacks under fumigation	
		Input	**Output**
1 Mon	4	0	4
2 Tue	4	0	8
3 Wed	4	0	12
4 Thur	4	0	16
5 Fri	4	0	20
6 Sat	4	0	24
7 Sun	4	0	20
8 Mon	4	4	28
9 Tue	4	4	28

2b - Area per Stack

Area needed is area covered by bins plus area outside stack for access to stack

3 bins wide X 6 bins long = 12 ft X 24 ft
3 ft added on each side for access = 18 ft X 30 ft.= 540 sq ft.

2c – Area needed for Fumigation rotation

Number of stacks in rotation = 28
28 stacks X 540 sq ft / stack = 15,120 sq ft.

Comparison using MBr = 2160 sq ft.

*** Plus cost of preparation of the new fumigation area. Floor surface must be non adsorbent to fumigant.

3 - Manpower Needed

Estimated 4 extra laborers

4 - Equipment Needed

7 times the Tarps
7 times the sand snakes
7 times the Tape

The above information shows that it would be very risky for the California Date Industry to rely upon Phosphine to fumigate newly harvested fruit and attain successful and profitable sales during the holiday season.

Additionally it indicates that the added costs related to using Phosphine would impose upon the packer additional costs and further erode any market advantage which may exist.

This financial burden would weigh heavier on the smaller date packer who would find it relatively more costly to tie up fruit containers, purchase additional equipment and labor than would the larger packers.